

June 9, 1958

Aviation Week

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**Pilot Report
On Skimmer IV**



McDonnell F4H-1 With Sparrow III



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AVIATION CALENDAR

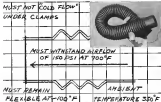
(Continued from page 5)

- Swing, Carle, Hans RMI, Elms, N.Y.
- July 6-10—The Society of the Aeronautical Sciences, National Science Meeting, A-1 Institute Hotel, Los Angeles, Calif.
- July 14-15—Transit Engineers, National Science Council for Aerospace Sciences, Aeronautical Laboratory, Moffett Field, Calif.
- July 16-24—Forum of Industrial Rubber Engineers for research scientists and engineers, Massachusetts Institute of Technology, Cambridge, Mass.
- July 24-25—1964 Second Symposium on Computers and Data Processing, Altamonte Hotel, Denver, Colo.
- Aug. 1—Midwestern Technical Meeting on Space Exploration, sponsored by American Rocket Society and the Institute of the Aeronautical Sciences, Fairbanks, B. D. Lawell, General Chairman, Space Exploration Meeting, 7330 N. Harbor Drive, San Diego 1, Calif.
- Aug. 6-8—Regional Technical Conference on San Antonio Motors and Motors, San Antonio, sponsored by the American Institute of Electrical Engineers, Hotel Statler, San Antonio, Calif.
- Aug. 13-15—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Locally sponsored by NBS, American Institute of Electrical Engineers and Institute of Radio Engineers.
- Aug. 17-21—Nuclear Operations Research Engineering Seminar, Pennsylvania State University, University Park, Pa.
- Aug. 16-22—Western Electronics Show & Convention, Institute of Radio Engineers, Anaheim Hotel, Los Angeles, Calif.
- Aug. 25-26—North Atlantic Council in Lunenburg, International Federation for Scientific Research, Bedford.
- Sept. 1-3—1964 Fairborough Phasing Display and Exhibition Society of Radio Engineers, Fairborough, England.
- Sept. 1-3-1964 Congress Engineering and Science, Massachusetts Institute of Technology, Cambridge, Mass.
- Sept. 6-10—First International Congress of the Aeronautical Sciences, Philadelphia Convention Hall, Philadelphia, Pa.
- Sept. 14-16—Annual International Automation Conference & Exhibit (International), International Society of America, Philadelphia Convention Hall, Philadelphia, Pa.
- Sept. 22-24—1959 Meeting, Professional Group on Telemetry and Remote Gas, Los Angeles, Hotel El Harbor, Marina Beach, Fla.
- Sept. 22-24—Second Annual Meeting, Standards Engineers Society, Binghamton, Binghamton, Pa.
- Sept. 24-Oct. 2—National Symposium, National Society of Automotive Engineers Inc., the Automobile Club, Los Angeles, Calif.
- Oct. 17-18—Annual General Meeting of the International Air Transport Association, Delhi, India.
- Oct. 27-28—East Coast Conference on New Aircraft & Navigation Electronics, Institute of Radio Engineers, Hotel Baltimore Hotel, Baltimore, Md.

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Intense cold down to -30°F or increasing heat up to 700°F , G-E Versilube F-30 exhibits the most consistent strength and long stability of any hydraulic fluid.

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Silicone Products Department, Watford, New York

Problem: Find a high-temperature sealant that will seal joints and hold them open.

Solution: Wire made with G-E silicone rubber sheath.

Exposed to a 300°F flame for hours, G-E silicone rubber insulation will insulate, forming an ash of silicon dioxide, as excellent non-conductor. No fumes from are released, nor will it shrink and expose the wiring, as the laboratory experiment on the left shows. Silicone rubber has superior dielectric strength at high temperatures and keeps it for years. It stands up well to oil and fuel splashes, has low water absorption. It is highly flexible down to -70°F .

Check into the specifications for silicone rubber sheath and question wire, for it stands like more than standard wire, and much less than other high-temperature wires. Technical literature and names of qualified wire and cable manufacturers are available on request.

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Solution: Specify G-E Class 700 silicone rubber.

Problem: Like this is already being, engine warming and engine-heating ducts are being successfully sealed with General Electric's improved Class 700 silicone rubber. With a service range from -120°F to 600°F ducts made of G-E Class 700 require prolonged heat at 500°F and can carry air up to 700°F . Tests given good resistance to common aircraft fuels and solvents, including MIL-L-7808. Ducts and duct connections made from G-E Class 700 silicone rubber exhibit low compression set—will not "cold flow" under clamps, ducts with improved flame resistance. Class 700 is proving to be the ideal material for all flexible hot air duct applications. Special G-E silicone rubbers are available for almost every application. Technical data on request.

Problem: Find a hydraulic fluid that functions over the -32°F to 700°F range needed for future aircraft.

Solution: Versilube F-30, General Electric's new silicone fluid, with the best performance over this range of any hydraulic fluid ever available.

Over the -32°F to 700°F range, only General Electric's new silicone fluid, Versilube F-30, provides adequate performance in all these areas: thermal stability, inherent viscosity temperature coefficient, excellent stability, even at theoretical temperatures well beyond its stability. No other commercially hydraulic fluid meets this stability. The thermal stability of G-E Versilube F-30—up to 600°F and for many applications, up to 700°F . Its stability is unequaled at temperatures as high as 700°F and remains stable to other hydraulic fluids in the moderate range. Versilube F-30 also maintains a more nearly constant viscosity than other hydraulic fluids over the -32°F to 700°F .

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Section D-13, Silicone Products Dept.

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RYAN HAS YEARS OF EXPERIENCE IN MISSILE DESIGN, GUIDANCE, PROPULSION

Modern missiles have not only changed the concept of global strategy—but also the concepts of test, speed and power. The considerable fuel consumption, acceleration and temperatures of these new man-made weapons have made manufacturing methods obsolete. Their superheats can cause a missile to run amok through winds, unstable combustion or wildly erratic guidance. Ryan is skilled in meeting the demanding precision of missile fabrication because Ryan has years of experience in designing, guiding and powering missiles.

DESIGN—Complete development of the Fushes jet drive missile—aerodynamic and engine design, quantity manufacture, and field service. The Fushes is in volume production for use by the Air Force, Navy and

MCAP. Ryan has also carried out extensive research on air launched vehicles and is engaged on a new project for an advanced type nuclear weapon delivery system.

GUIDANCE—Development of advanced military radar systems for supersonic missile guidance; RANAV (Ryan Automatic Navigation). Doppler systems, and ground speed indicators and homing devices for helicopters, strikejets and VTOL aircraft. Ryan is pioneer in continuous wave radar techniques.

PROPULSION—Manufacture of powerful liquid rocket motors for surface-to-surface, air-to-air, rocket combustion chambers for ground to air missiles and various high temperature components used by turbojet-powered missiles.

RYAN BUILDS ONE-HUNDREDTH BOEING JET TANKER AFT FUSELAGE

Stage aft fuselage sections for Boeing KC-135 jet tankers are now rolling off the Ryan production line at the rate of 18 a month.

Production of the giant airborne structures is well past the 100 mark and ahead of schedule.

Ryan and Boeing have been in pro-

duction partnership for more than 18 years. Ryan also built 808 fuselage sections and including pods, external wing fuel tanks and other components for the KC-135's predecessor, the post-war KC-97. The KC-97 production line met "on schedule" deliveries for seven years.



PACKAGED POWER FOR DOUGLAS DC-8s

Complete jet engine pods and supporting wing pylons for the new Douglas DC-8 Jetliners are now entering full production at Ryan. Ryan has been a major producer of complete ferryaircraft and occasional power plants since 1950.



VERTIJETS® CAN GIVE U.S. THE ADVANTAGE IN AIR POWER

Unlike conventional jets, Ryan's Vertijet is not dependent on vulnerable runways and air bases. It can be widely dispersed in rough terrain or forests, or in underground "bunkers." The revolutionary craft takes off and lands straight up and down on jet thrust. Cockpit Vertijets will be more maneuverable and faster than conventional jet fighter-bombers, more reliable and accurate than ground-to-air missiles.

"Each vertijet takes off, jets on power as a tactical advantage never before realized," says a top expert on air power. "as revolutionary a change in tactics and strategy as the jet engine itself."



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Ryan Aeronautical Company, San Diego, Calif.



THE ARMY'S H-23D RAVEN: INVESTMENT IN TOMORROW

Over 20 major improvements distinguish the H-23D as one of today's most advanced helicopters. But several features in particular verify its unmatched growth potential, which is a prime requisite for the evolution of any helicopter investment.

Basic Ruggedness: The H-23D has the highest flight and landing load safety factors of any two or three place helicopter flying today.

Component Life: The H-23D's 250 horsepower is available full-time, without restrictions wearing of standardized service life. In fact, all existing components are designed to accept considerably greater horsepower and to attain an overhaul period beginning at 1000 hours.

Functional Versatility: More power... more cabin space... further qualify the H-23D as a multi-mission helicopter, looking up a basic Army concept: more utility from fewer units.

The H-23D is now prepared to receive a new 300 horsepower engine, without further major modification. The resulting UH-120 (prototype now flying) has already demonstrated a performance which will capture new missions beyond those previously conceived for this helicopter class.



HILLER HELICOPTERS

TRAD ALTO, CALIFORNIA

Washington Roundup

Reorganization Fight

President Eisenhower has reversed his position and decided to fight it out with the House Armed Services Committee headed by Rep. Carl Albert (D-Ga.) over the proposed reorganization of the Defense Department. The measure is slated for House action.

A few weeks ago, the President recommended the congressional legislative amendments approved by the House group, 12 to 6, among only two objections to it in valid language (AW May 26, p. 25).

But in the hour for floor action approached, the President issued a strong blast against proponents of the measure at a session with his own staff which, he declared, would "continue to emphasize clarity and simplicity with the Defense Department. They continue to imply Congressional approval of wasteful duplications, administrative delays and inter-service rivalry." The President would.

• Repeal the Secretary of Defense to administer the department through the three service secretaries. The President declared, "puts a positive an unnecessary barrier to better Pentagon work." He said it would give the "color of legality" to "frictions, delays, duplications."

• Repeal congressional review of any change or abolition of "major" executive functions. This, the President predicted, "allows one military unit to hold up defense improvements for some months and perhaps block them altogether."

• Authorize the service secretaries and chiefs of staff to present their individual views to Congress after first consulting the Secretary of Defense. The President charged that this "invites misadventure to the President and Secretary of Defense, endorses the idea of duality and blocking of defense administration, suggests that Congress' hopes for administration and inter-service relations."

House Republican leader Joseph Martin (R-Mass.) and Rep. Charles Cannon (D-Mo.), chairman of House Appropriations Committee, are backing the President.

Soviet 'Fishing'

Hall-Downer Soviet "fishing ships" riding at anchor in international fishing waters 100 miles off Nova Scotia are suspected of investigating new air defense and anti-missile radar installations now in service at Boston less than 100 miles away. That that number of ships adds value and that a departing ship is always replaced suggests that Soviet ships are seeking to learn characteristics of new radar for possible electronic countermeasures.

No Fixed Profits

Defense Department has issued House Appropriations Committee it will have a uniform set of cost principles to apply to all major contracts by the end of the year. On profits, the Defense Department is finally stating some congressional pressure for a fixed profit limitation. Previous McGee, Assistant Secretary of Defense for Supply and Logistics, explained to the committee.

"We feel that price guidelines in the field of profit allowance must be stated in uniform general terms under the factors affecting a reasonable rate of profit runs in each contract. Within the overall analysis, for instance, there are wide variations in the factors which determine a reasonable rate of profit such as in the extent of government assistance, in the risks assumed by those contractors and in the efficiency with which contracts are performed. Accordingly, we do not feel that it would be appropriate to establish any specific profit rates applicable to this or other industries." The Congress has recognized in the Reorganization Act the factors which determine a reasonable rate of profit.

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Communications Compromise?

Compromise which might enable airlines to operate Doppler radars at 5,500 mc for the life of the equipment or some other reasonable period, providing they are willing to take interference from airlines, radio, may come out of an impromptu discussion by airlines, Defense Department and Federal Communications Commission representatives at last week's Armed Forces Communications and Electronics Area committee. Individual parties to the Russian situation conflict, which threatens to block early airline use of Doppler radar (AW May 26, p. 25), may hold local working session to attempt to work out details.

Navarra Halted

Air Force has halted development of Navarra long-range navigation system and will use self-contained airborne Doppler and/or inertial systems for its combat aircraft. As House plans no further long-range ground-based navigation system development for tactical use, Lt. Col. D. J. Evans told the Armed Forces Communications and Electronics Area committee. Evans, deputy chief of Naval Branch, USAF headquarters, fully denied reports that Doppler navigation might replace Terrain for short-range navigation, stating that Terrain would remain USAF's primary short-range system for at least the next decade.

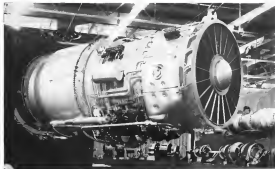
Durfee Warning

Civil Aeronautics Board Chairman James Durfee last week warned against the abandonment of existing air traffic radars in favor of "a shiny new system that will somehow, magically, produce safety in the air." However, Durfee apparently was not voicing opposition to the proposed Federal Aviation Agency plan (page 26). He was saying that air traffic radars should not be dropped because of high hopes for a complete system that will solve problems overnight.

Missed Opportunity

Nearly 400 members of the House missed an opportunity last week to participate in an event that may eventually change the nation's way of life. Less than 40 representatives were on hand when the House voted to create the National Aeronautics and Space Administration to lead the U.S. in the exploration of outer space. Although little further was attached to the passage, Rep. Kenneth Keating (R-N.Y.), a member of the House Space Committee said, "Taking the long view, we are convinced that this bill will be the most significant legislation to come out of the current Congress—in addition to come from space. Congressmen have the road history stopped all over it."

—Washington staff



PRATT & WHITNEY J58 Mach 3 turbojet is at least one and a half feet larger in diameter than Pratt & Whitney's J57 engine.

J58 Reflects Navy Development Changes

By J. S. Behn, Jr.

West Palm Beach, Fla.—Changing Navy philosophies of jet engine development is being reflected in Pratt & Whitney's J58 Mach 3 turbojet now running on the test stand.

New philosophies call for a sharp increase in the number of running hours logged before an engine completes its 150-hour test and is accepted for production.

The move reflects Navy experience showing that the ultimate cost and operational success of an engine in flight are almost a direct function of the amount of testing performed during the development period.

In the past it was eight engines

per model engine have been authorized for a complete development program, leaving but fewer test and often resulting in long delays for repairs and rebuilding. Under the new policy, Pratt & Whitney will build approx. 10 test J58s in the experimental shop of its new Florida facility, which is to be complete, actually, should be tested a small factor. This shop, part of a \$30 million Pratt & Whitney investment, contains 525,000 sq ft of the largest and most modern machine tools supplied by the Navy.

Florida Test Facilities

Testing facilities at the Florida site now consist of four open air jet engine test cells located five miles from the

engineering offices and shop so that they do not require soundproofing. Instrumentation at these cells and other test areas has been fitted with a \$10 million instrumentation from the Air Force.

Altitude testing of the J58 will be conducted at Pratt & Whitney's Wild goose Laboratories at West Hartford, Conn., and at government facilities.

The J58 gives the U.S. a backup program and two turbojets in the Mark 1 plant. The other engine is General Electric's J59 which already has been designated as the powerplant for two Mach 3 plus North American aircraft for the Air Force—the two-engine B70 bomber and the two-engine F-105 long-range interceptor.

Navy has not yet indicated for a Mach 2 aircraft to be fitted with the J58. Recent statements by Navy officials indicate that they believe that the engine development time will be much longer than that for the earlier engine. Therefore, an appropriate engine and its cost program would be determined after the powerplant's capabilities become much more definite.

Apparent reason for this approach is the serious difficulty the naval aircraft program suffered several years ago when the J40 engine failed to meet its original specifications. A major portion of the Navy's new aircraft designs



CERTAIN to the use of the J58 (left) around the structures, Pratt & Whitney will build 10 test J58s in Florida.

at the time had been produced on these specifications.

Many tests are being used experimentally, with both the J58 and J59. Proper use of the chemical fuel and its ultimate availability, and attractiveness to cut out apparently still some other question.

To relieve the most efficient at basic design for a given engine, however, the decision to begin either chemical or petroleum fuel or some debate consideration of the two must be made at the very beginning of the design.

The Pratt & Whitney facility in Florida is located on a 10 mile square tract which is over 30 miles from any populated area and about 10 miles from Palm Beach. Selection of this site on the edge of the Everglades has new engine development work, not based on mass factors but the primary considerations included obtaining maximum isolation with close proximity to a desirable living area to attract personnel.

Isolation Required

Isolation was required to maintain good manufacturing relations while developing very large and run more modest engines and other high speed powerplants that Pratt & Whitney has long been assumed to be working on. Confirmation of a portion of this program cost at the collection of the facility since Lt. Gen. Clarence S. Ivins, USAF, deputy chief of staff at material, indicated that Pratt & Whitney's an-

teity included work with hydrogen fuel (AVN June 2, p. 25).

Initial investment of \$50 million in company money in the Florida plant follows a well-established United Aircraft policy of acquiring its own experimental facilities to speed development work without having to rely on outside laboratories. During the past 10 years, the corporation has spent more than \$200 million in construction of new facilities.

El M. Brown, chairman of United, announced at the dedication of the Florida plant that the board of directors had voted to spend another \$50 million within 15 months, the major portion at the Florida facility.

In speaking at the dedication, both Gen. Ivins and Sen. John R. E. Dixon, chief of Navy's Bureau of Aeronautics, called for more investment of this type by industry as the best method of securing its future.



OPEN AIR jet engine test cells are located four miles from offices and experimental shops.



OFFICES, engineering sections are at rear side of building; experimental shop on far side.

31



DOUGLAS Aircraft Co.'s DC-8 jet transport, shown here on first flight, completed its second flight at Edwards AFB last week. Aircraft was in the air for 2 hr. and 1 min. during which it extended envelope of speed and altitude of first flight.



DOUGLAS DC-8 on first flight. Aircraft weighed 179,000 lb. and lifted off after 5,100 ft. one at speed of 140 kt.

DC-8 Moves Into Flight Test Program

Long Beach, Calif.—Douglas DC-8 moved into the flight test phase of its development work earlier, take-off on its Memorial Day test flight. The first DC-8 underwent two hours of taxi, ground system and handling tests over the Pacific Ocean before touching the coast near Santa Barbara and landing at Edwards AFB.

Flame wall, engine exhaust, heat shields and about 10 hr. have been logged, after which it was taken here for flight tests. Flight test program will be assigned to the test program and 25 will have been completed by the time the test program is ended.

Since will be delivered before next release to allow sufficient time to meet carrier before commercial service, because legal first deliveries are scheduled for the summer of 1959. Domestic service should start by the end of that year and international service should start about 90 days later.

The DC-8 lifted off after a 3,100 ft run at an speed of 110 kt. The airplane weighed only 179,000 lb. at lift-off—1,000 lb. more than maximum landing weight. From JT4D-6 (JT7) engines generated drive before service as they developed a total of 30,000 lb. thrust with water injection at takeoff.

Observers near the runway reported comparatively low noise level from the engines which were equipped with an experimental multiport sound absorber. Most objectionable noise at

close range was compressor wheel noise which observers found then negligible.

Carburetor, fuel and oil system equipment intended for delivery at plant was not available.

Tests on first flight were carried out at altitudes up to 11,000 ft. The airplane was checked for ground handling characteristics and handling, electrical and air conditioning systems were noted out. Some of the right side transfer panels on the test airplane were replaced with emergency pressure relief valves in case with possible failure of the regular pressure control valves.

Total of 118 DC-8s have been ordered to date with a total value of \$700 million. Northwest Airlines is expected to sign an order for several more shortly. Douglas has received about \$275 million in the DC-8, so far.

First 90 airplanes will include the engine and interior models, three different powerplant systems and four different customer configurations. The memoranda the customer and domestic versions are identical, but overwater version has been given intermediate wings in providing additional 26,100 lb. of fuel and by increasing strength of wing and landing gear.

Most DC-8s, now in order will be powered by the Pratt & Whitney JT3 (JT4) and more overwater craft will be powered by the Rolls-Royce Conway four engine will fit with the previous Pratt & Whitney JT3 (JT7). Second

will have the JT4. First JT4-powered DC-8 will be delivered to Pan American World Airways in December, 1959, and the first with Conway will be delivered in February, 1960.

Airplanes powered by the JT3 have four separate engine-driven powerplants with injection system with four 150 gpm supply tanks. The tanks are provided to ensure a power flow at starting. JT4 and Conway versions do not use water injection.

Western Strike Ends

Los Angeles—Pilot ended the long Western Air Lines strike by returning to work after the company last week. Airline will resume operations in 26 cities on June 19 with 11 flights monthly to a new schedule dependent on the weather.

Since approximately one-half of West coast fleet is stranded in the Los Angeles area with most flights originating from there, last day's service also will include flights from Los Angeles to San Francisco, Seattle, Vancouver and Salt Lake City.

In accordance with an agreement signed by company and union representatives, first flight will be operated by pilots with greater seniority. Aircraft are being thoroughly cleaned prior to 100-hour check and complete flight tested by experienced pilots prior to returning to service (AW June 2, p. 31).

End to Transportation Excise Tax Urged in Senate by Smathers

By Fred Eastman

Washington—Sen. George Smathers (D-Fla.) opened a determined drive on the Senate floor last week to eliminate the excise tax on transportation of personal and property interests imposed during World War II to encourage shipping and travel.

Smathers termed the tax as one no longer applicable and one which is operating directly against the best interests of the government.

He said that the tax money goes out of the Treasury from the bottom of the fees of taxation and other ways at last or faster than the money goes in at the top.

Advantages to be Gained

The Smathers and those advantages would be gained from removal of the 1% freight tax and 10% passenger tax.

"There would be only an insignificant drop in tax revenues—perhaps even a gain."

"Removing the excise would stimulate the entire transportation industry."

It would encourage traffic in such the same fashion as the tax encourages traffic.

"It would unquestionably lower prices to the consumer—not only directly, but—referring the cost of time and pass-freight, but indirectly in the goods and services in which tax costs are now passed."

"It would improve the competitive position of small business by eliminat-

ing what is essentially a tax incentive for big business."

"It would secure a taxpayer further from our present tax structure—taxing things we can easily do without."

"It would give a shot in the arm to the industry, which are losing profitable new. It would help all regulated motor carriers and might well save the entire bus transportation system. It also would greatly assist airlines who have mounting operating costs with little or no income in traffic."

"It would be a direct and essential contribution to the health of our economy which depends on large capital expenditures from the entire transportation industry."

Smathers said 46 other members of the Senate earlier indicated that they would support repeal of the transportation excise tax but that some may have changed their opinion following Postmaster Clegg's recent statement that he hoped to hold the line against tax reduction.

Smathers' Interpretation

Sen. Hubert H. Humphrey (D-Minn.) said he interpreted the President's declaration against a tax reduction to mean that he does not want a loss of revenue. "Thereafter," he said, "I believe we can improve the President's position as to revenue by the repeal of these two taxes, because they are reducing government revenues every day."

Voters say in which the excise tax

on transportation would reduce government revenues was explained that can be in Senate supporters.

"Tax imposed during the war to encourage travel and shipping still accomplishes that purpose, resulting in a loss of income to the industry. Since certain segments of the industry operate at a loss, revenues brought into the Treasury at the top through the tax are drained off the bottom through subsidies."

"Tax has not only discouraged shipping and traveling on common carriers but has diverted a considerable portion of what there is to private carriers, resulting in a big loss in income tax collection to the government."

"While the amount of revenue received through the tax has dropped since the war, the cost of collection has increased to further reduce government income."

"Transportation has also a deductible from income as business expense to the taxpayer and the amount paid for the Treasury is at least partially offset by the available loss."

Discrimination Charge

Senators backing the repeal movement said that the tax also is a discrimination to the consumer. For example, that and, shippers of large quantities have done only transportation services and therefore pay no tax. If they do ship by common carrier, their rates are lower since the shipments are in big lots. Smathers shippers will not have to pay transportation tax as common carriers but must pay a higher rate because of the smaller shipments.

Another discrimination, because of this tax, Smathers said, is the additional tax due against air shippers who must ship their products long distances to market and still compete in price with products shipped over short distances. The long distance shippers not only pay a tax higher shipping costs but in fact pay a higher transportation tax than the short shippers.

Los Angeles to Lengthen Runway for Jet Service

Los Angeles International Airport will lengthen its present runway 212 to 20,000 ft. from its present 1,500 ft. to provide better takeoff and landing for certain jet aircraft.

Estimated to cost \$400,000, the project, in addition to the cost of 1,000 ft. of runway, will include building approach ways and lighting. The project has been approved and bids for construction are being invited. Completion date is set for Nov. 1 when first Boeing 707 is scheduled to go into operation at American Airlines. Kennel 707, is designed the minimum of construction of the dual runway's now paralleling the terminal area.



ARTISTS' view of new Tulsa airport terminal shows tax, it will occupy north end of 10,000 ft. runway (lower center). At right is Douglas Aircraft Co. plant. American Airlines overhead bus, now undergoing \$20 million expansion, is at south end of runway.

Tulsa Plans Second Terminal for Jet Age

By Cong Levin

Tulsa—New airline terminal will be built here to accommodate traffic increases expected when jet transport goes into service. Terminal project will be part of \$45 million in construction scheduled for the Tulsa Municipal Airport complex, one of the last major ones.

Tulsa voters recently approved a bond issue which permits the Tulsa Airport Authority to move ahead with its \$5

million terminal project. It is scheduled for completion in 1962.

Across the field from the terminal, American Airlines already is at work on a \$20 million expansion of its aircraft facilities to accommodate turbine transport on order. And next to the American Airlines, the Air National Guard plans to start work on a new base.

New Tulsa terminal will allow the airport to be run as a dual operation. Terminal will be near the 10,000 ft

main runway which will accommodate all traffic operations. About a mile west of the main runway is a pattern of shorter runways which can be used for business and private flying.

Present main taxi, control tower is a separate structure which stands between the old and new terminal and will continue to control the two operations.

New terminal will provide 16 loading positions, compared with eight at the



MAIN lobby on second level of new Tulsa terminal (left) will be reached by escalator. Below at right shows roadway entrance with ticket office on ground level.



Vickers Assembles Continental's Viscount IIs

Vermont 114s (Viscount IIs) Continental Air Lines are shown on Vicksburg-Vermont (Aircraft) left. First assembly line begins first class service with the 16 passenger Vickers Viscount between Chicago and Los Angeles (AW June 2, p. 14).

AIRLINE OBSERVER

►Indian contractors over the no-show control plan has been building after this among were a compromise agreement was adopted last month by the Air Traffic Conference. Australia Airlines opposition to the plan (AWM May 26, p. 39). Possibility is now strong that a variety of hand-les will meet an effort to water down either the reconfiguration or transi-tion time limit on ticket pickup phases of the plan, although most airlines will be willing to let the 33 percent plan drop from the picture. A sharp split will exist with American supporting a near 100% plan, while Eastern will lead forces advocating the plan in its present form.

►Heavyweight Civil Aeronautics Board on the Las Vegas crash calling on April 31 was extend beyond the scope of annual accident investigation. CAB is hopeful of taking a deeper look into the relationship of civil to military traffic and wants a report on the case that will detail the overall problems basic to the collision hazard.

►Generalized Mandatory Time (GMT) will be studied time for all domestic operations effective June 15. All flight plans will be filed by GMT and all Civil Aeronautics Administration actions and navigation procedures will be conducted with GMT standards. Passenger schedules and published arrival and departure flight times will not be affected. Purpose of the action is to get a clear conception of international and domestic navigation procedures. Airlines have been preparing for the change-over since last October.

►Anadarko, Sweetwater Airlines, is converting all its B-44s, twin-engine B-14F transports to accommodate 24 passengers, thus providing more mil-lions of miles additional revenue annually. The modification, which re-quires strengthening the lower part of the fuselage, will give the B-44s the same seating capacity as the newer, larger B-44Ns. East Central began manufacturing 26-passenger B-44Ns last year.

►American Airlines has placed an order with Federal Telephone and Radio Co. for Texas portable distance measuring equipment (DME 1) to be installed on the carrier's fleet of Boeing 747 jetliners, conforming to new regulations by Aviation Rules (AWM May 12, p. 40).

►Presidential Interlocking board completed its hearings in Washington last week on disputes between Eastern Air Lines and Air Line Pilots Assn. and Flight Engineers International Assn. Decision in the case which began in New York Feb. 10 is expected in about a month.

►U. S. has won its fight for a cut in its annual contribution to the Inter-national Civil Aviation Organization, although the amount of the reduction is not as great as originally sought. As a result of U. S. position, various sets of member associations will be studied before further adjustments in con-tributions are made.

►Rate of return of Class C airlines declined to 2.37% for the 12 months ending April 30 from 1.67% for the same period in 1957, according to an estimate by the American Assn. of Airline Pilots. Net income for the group dropped to \$121.5 million for the first four months of 1958 from \$295.6 million reported for the first four months of 1957.

►An Coordinating Committee has scheduled an international symposium on "U. S. domestic short distance navigation routes-Vietnam-and its relation-ship to the international air navigation system." Institute to aviation officials and agencies in foreign countries are being invited through the State Department. ICAO has scheduled a special meeting in February on short distance aid and their relationship to other elements of the air navigation system.

►Northwest Airlines will deliver implementation of its monthly-gated Chicago-Miami route until after Oct. 1. When service begins, the airline will offer first class service with Boeing Stratofortress, main service with DC-6Bs and a combination first-class/coach service with DC-7Cs.

SHORTLINES

►Civil Aeronautics Administration has published a booklet on regulations and procedures for administration of the law and usage provisions of the Federal Aid Airport Program. The booklet, Federal Aid Airport Program, Letter Standards and Publications These documents, was prepared for guidance of airport project sponsors and contractors performing work under the program. Booklet can be obtained without charge from Civil Aeronautics Administration, Washington 25, D. C.

►Eastern Air Lines has taken delivery of its last piston-powered aircraft under its 5475 refund expansion program. The Douglas DC-7C is the last piston engine to be delivered before Lockheed delivers the first of Eastern's fleet of 40 Electra turboprop aircraft. First Electra delivery is scheduled for September.

►Piedmont Aviation Inc. in its final call report to stockholders, on the first quarter of 1958, said the airline expects first delivery of the Fairchild F-27 in June. The aircraft will be used for training purposes during July with three more F-27s scheduled for delivery in August. Five additional F-27s are scheduled for delivery in September and October.

►Trans World Airlines has filed formal notice with the Civil Aeronautics Board for temporary suspension of its service at Logans, Kan. TWA says Central Airlines is local carrier that will soon begin service between Kansas City, Topeka and Wichita, it is the best position to accommodate Topical's traffic flow in both Kansas City and Wichita.

►United Air Lines has increased its weekly flight schedule from Colorado to Denver to 10, with 10 flights weekly in each direction. First class flights from Los Angeles to Denver have been increased from four to seven and main service from seven to nine each week. San Francisco-Denver first class service is up from four weekly to five and main from seven to nine.

►U.S. Post Office Department's new 7-cent air mail stamp will feature picture of a composite bi-fuel transport. The stamp will be available on Aug. 5 when the new postage rates go into effect.

►Flying Tiger Line air freight service during April reached 10,000 tons, the highest net or net recorded for that month. Traffic showed a 14% gain over April, 1957, when tonnage totaled 8821,812.



The Avro Arrow is shown in flight during test maneuvers over Ontario.

The Arrow weapon system is a beam-destroyer having super-sound missile capable to



The Avro Arrow is as big as a World War II bomber yet took off on its first flight in only 1,000 feet of the 11,000 feet runway at Downs.



AN ARROW IN THE SKY

Since its first flight on March 25th, the Avro Arrow has been meeting the vigorous demands of its extensive flight test program. Proceeding according to plan, the Arrow flew faster than sound on its third flight, and more than 1,000 miles per hour on its seventh flight.



AVRO AIRCRAFT LIMITED

(MONTREAL - CANADA)



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HARVEY

Aluminum

MISSILE ENGINEERING

Bomarc Checkout Unit Simulates Flight

Dallas-Missile engineer developed for the Boeing Bomarc can provide an operational checkout of the interceptor missile's guidance system by simulating flight action.

Both in Space Corp. from a First with Electronics Co. design, the Bomarc flight simulator can be used for periodic checkout of the missile when it goes into storage at operational units. It can also be used for preflight checks.

Part of System

Simulator is part of a complete system for checking out Bomarc and its components being developed by Flamingo.

Space Corp. has built three of the machines, and three others are being fabricated by Boeing-Liaison Electronics Corp.

Bomarc encounters have been detected to Cape Canaveral, Fla., and to Boeing Aerospace Co., Seattle. They are used in the test program now, but they are designed for use as operational test equipment to keep Bomarc in peak condition in the field.

The machine has not yet been ordered in quantity.

Missile engineer can simulate roll, pitch and yaw motion. Bomarc is clamped on the machine and put through a series of automatically programmed tests.

Program provides a readout on the instrumentation system from outputs designed into the missile to facilitate testing.

Exciter is a 30,000 lb. complex of heavy steel frames and complicated linkage.

It is 25 ft. long and 10 ft. wide, and its 34 beam base is bolted to a concrete pad.

Above the stationary main base are three separate frames. Two frames are attached to the base through a central bearing, and the pitch frame sits on the yaw frame and is attached to it. The roll frame is suspended in the pitch frame, and the Bomarc is clamped in the roll frame.

The 7,400 lb. guidance used to test the missile is loaded with an electrical crane, and parameter Bomarc will be loaded the same way.

Can Be Towed

Major feature of the exciter is the fact that it is a towed system. Its frequency of motion is two cycles per second, and this rate is constant to all three motions. The machine is driven

by a standard type of hydraulic system.

Tension tubes are used to get and maintain frequency and amplitude. Spring effect is selected by a boost from the hydraulic system, then the motion automatically loads impulses which are not strong enough to supplement the spring motion and maintain amplitude.

Yaw frame moves 4.5 in. from the center line in each direction by a total movement of 9 in., and other motions are on the same order. Missile goes through yaw, pitch and roll motions one at a time, and when one frame is in motion, the two other frames are locked. Testing can move from one motion to another in any sequence.

Hydraulic Locking

Quiet frames are locked by hydraulic cylinders which drive into pins locking a subframe. The machine is additionally equipped with an emergency brake switch which shuts it down when

amplitude exceeds the operating rate. Machine is driven by a variable displacement pump with booster. It takes 500 psi to run the unit on all motions, but it is pressure tested up to 1,000 psi.

Bomarc is attached to the roll cradle with two large straps. Cradle also has an elevating screw mechanism which presses against the missile's rocket web, giving added rigidity and a locking effect.

Air Transportable

Machine exciter is air transportable, along with the rest of the Flamingo system.

Exciter's portability is limited by the fact that it needs a concrete pad.

Flamingo system has 90 pieces of test equipment for checking out the missile and its components, all of them of a go, no-go type. System is designed for use by civilian crews with no extensive technical training.



Jupiter Nose Cone Survives Re-entry

After successful 1,000 mi. flight from Cape Canaveral, Fla., Jupiter intermediate range ballistic missile nose cone is recovered and parked into steel shipping container for trip back to Army Ballistic Missile Agency. Although of nose section, apparent nose heat, used to keep re-entry test from penetrating shell and causing cone to become intact.



MAGNETIC tape drives behind control console of IBM 705 increase data processing speed.

Norton AFB Will Process Data To Expedite Missile Logistics

San Bernardino, Calif.—Electronic data processing center for direct support of ballistic missile program was officially opened here at Norton AFB. Scheduled to be completely operational in July, the center will be managed by Directorate of Ballistic Missiles, just formed for that function in Air Materiel Command's San Bernardino Air Materiel Area, headquarters located at Norton.

Data processing center will be able, in a matter of minutes, to handle difficult logistics problems associated with the Atlas and Titan intercontinental ballistic missiles. And their intercontinental range ballistic missile, and to expedite management actions in connection with supply, maintenance, transportation, quality control and other factors. This operational capability will allow increased fast liaison between AFMCA's Ballistic Missile Manager, Maj. Gen. R. A. Fink, ballistic missile operating squadrons, supporting AMC bases and missile contractors to initiate vital action in minimum lapse of time. In some cases the center is expected to reduce stock supply requirements from 45 to 15 days.

Heart of data processing system is general purpose, digital computer, International Business Machines Corp.'s IBM 705. Computer will accept data from operational units, pass information to weapons release storage; info depot or contractor, and act as medium for swift responses. Transaction information will come over transmitter networks in and out of the control loop.

tion, linked by teletype circuits. This communications system will connect the data processing center to the AMC transmitter network and with Air Force administrative telephone network, Air command.

Number of transactions the data processing center's installation can process is limited only by space considerations.

IBM engineers, in cooperation with several other communications manufacturers, are studying specific areas of operating transactions with maximum.



MAGNETIC tape units at Norton AFB store data relating to ballistic missile logistics.

In the area of inventory control, the center will:

- Permit worldwide accountability and control of assets, automatic supply and pricing up-to-date record data.
- Facilitate requirement and budgetary computations.
- Enable ballistic missile managers to balance stock levels at optimum points.
- Minimize problems of disposal and obsolescence of equipment.
- Give accurate data for cost accounting and use of transportation.
- Aid in cataloging and programming of maintenance schedules and workloads.

About 200 Air Force personnel will be on 24-hr duty at the processing center.

Five full-time IBM technicians will be assigned there to handle the center's equipment maintenance.

IBM 705 computer, expanded greatly at Norton by the addition of more auxiliary components, will include 33 magnetic tape units, each capable of storing five million bytes of information. System is expected to ultimately require more than 3,000 reels of tape in its library.

Indications are that Air Force is also thinking of applying the electronic data processing system to aircraft logistics because of the increasing complexity of weapons systems. In such a case the processing system would have to be linked with aerial projects of the weapons system.

Kos personally associated with the processing center at Norton are Maj. Gen. E. W. Anderson, commander of San Bernardino Air Materiel Area, Col. Philip B. Foster, head of the newly created Directorate of Ballistic Missiles, and Col. Robert L. Kohn, who will direct technicians in the operation of the center.

British Conducting Shock Tube Tests

Yorkington, England—Nine profiles of shock-tube tests at the National Physical Laboratory here have concerned British scientists of two things:

- Shock tubes are useful tools for hypersonic and physical studies.
- Accurate data, obtained in about a dozen shock tube in half-a-dozen less than, is "quite accurate."

National Physical Laboratory's hypersonic shock tube, built in a development stage for a planned type, has a 1-in. dia. in the driver and a 1.5-in. dia. working section. Mach numbers of approximately nine can be reached at a lower inlet velocity of 300,000 ft., with an upstream pressure of 200 atmospheres.

Siggo Tube Planned

The next tube will be double the diameter in the driving section, and will maintain Mach numbers up to 20 and velocities down to about 30,000 ft., carrying upstream pressures of the order of 1,000 atmospheres.

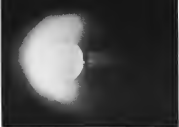
In addition, National Physical Laboratory scientists have designed a helium tunnel and is now operating a small water-cooled electric arc tunnel. If funds become available, they intend to build the helium tunnel and may possibly convert it a condenser bank for operation at the electronic tunnel similar to the "shocklet" system developed by engineers of the Air Research and Development Command's Aeronautical Engineering Development Center (AWF-24, p. 39).

Scientists working on the shock tube tests advise today the leadership of the U.S. in this area of investigation, and carry the number and variety of these installations in America. "About all we've done so far," and are "in to confirm that data from our accurate and highly useful data."

Photography Objective

A basic investigation in the National Physical Laboratory shock tube tests centers around the physical mechanisms of starting. The whole problem is to get a brief sequence of pictures in the shock wave passes the object in the tunnel, all in the interval of a fraction of a microsecond. A standard ballistic camera of the Coma-Schneider type has been adapted by National Physical Laboratory technicians to do the job. The camera takes eight pictures in sequence at the rate of about three per microsecond. Isolated into the observation system, the camera supplies eight high-intensity pulses of light made in a rapid 840.

The light sources are spaced in a



SHOCK in British National Physical Laboratory hypersonic shock tube glow at speed of about Mach 9, sustained about 300,000 ft., supersonic flow, about 7,500 ft.



TWO bumps in head of shock wave shows on oscilloscope fluorometer. Hypersonic flow dynamic studies are made in 15-in. working section of British development shock tube before.





Erector tines for USAF's Titan air-launched ballistic missile are being constructed at Kiewit Steel Corp.'s Steel Fabricating Plant at Montebello, Calif. Above, heavy steel sections of base tower structure is welded. The Mayne Co. is prime contractor for Titan.

Titan Missile Ground Support Equipment Includes Steel, Aluminum Erector Tower



Overall view of heavy steel section of tower is shown above. Bottom plate forms the dome-shaped masonry and ladder which run vertically through the tower tower for the complete missile. Access platforms in different levels of the tower are at the right of the structure.



side around the central line of the reference series and register the picture on various stages on a standard photographic plate.

In the photo-study shock tubes, three-camera microscope equipment is being used to study the electron density of a high-speed shock system. The importance of such a study is limited at its knowledge of the high degree of ionization of air at the nose of a ballistic missile.

Tracking Telescopes Use Special Gears

Reduction drive of an 84-ft. dia. radio telescope for tracking missiles, satellites and stars has a maximum gear ratio of 1,948,000 to 1.

Final reduction of the drive is a 59 in. center distance double enveloping worm gearset. Secondary gear is cut into the outside diameter of the steel nose of a large ball bearing which supports the paraboloid antenna. The bearing is cut inside around the gear at a rate of one revolution per day.

Contact was established by General Motors Division, Machine Tool Co., Detroit Mich. D. S. Konech & Co., Calumet, Mich., is in the process of building six of the telescopes for installation in various parts of the world.

Bomarc Control Job Goes to Westinghouse

Westinghouse Electric Corp. will develop and test an advanced ground control system to guide the Bomarc air defense missile. Contract, approximately \$10 million, will be underwritten by the company's Electronics Division, Baltimore, Md. Prime contractor for the project is Boeing Airplane Co.

Project, connected with Boeing's over-all subcontract of Bomarc weapon system, calls for development of ground guidance of the missile to a point where Bomarc's built-in terminal guidance will take over and lock the missile on target.

Advancements called for include control of the missile over longer ranges, ability to "trade" information automatically with other Bomarc ground stations, indication of target size and the ability to track many targets simultaneously.

Lockheed Division Expands Navy Polaris Development

Lockheed Missile Systems Division will expand Navy-owned Polaris development facilities at Sunnyvale, Calif. Officials said accelerated tempo of entire Polaris program has advanced several phase dates originally set for next year.



Draped with heavy canvas protective cover, Jupiter intermediate-range ballistic missile is loaded onto Douglas C-114 for shipment from Army Ballistic Missile Agency at Huntsville, Ala. to USAF Missile Test Center, Cape Canaveral, Fla. Jupiter is transportable by ground sea or air. First full-scale ICBM test runs to successfully convert to early into the earth's atmosphere was launched by an Army Jupiter from the USAF Missile Test Center, Cape Canaveral, Fla. (NW May 25 p. 31)

Jupiter Prepared For Launching Test



Missile technicians work on nose section of Jupiter (lower, left). He probably is adapting various instrumentation. Pattern of gentry above is at right of picture. Photo at right shows entire missile and support complex, with gentry in position at the launch pad. Extensive tests are made on missile and its control equipment until just prior to the actual launching. Gentry moves to a safe distance once time before Jupiter is fired. Markings aid visual tracking.



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AERONAUTICAL ENGINEERING



FLIGHT view of McDonnell F4H-1 shows aircraft in traffic pattern, gear and flaps down. Note extended drop in horizontal tail

F4H-1 Stresses Range in Navy Order Bid

Navy's new McDonnell F4H-1 jet fighter, which has just made its first flight, appears to be roughly comparable to competing Chance Vought F4U-1 at altitudes below 60,000 ft since both aircraft have same speed limit above Mach 2.

However, F4H-1 has greater stroke capability because of rocket engine. Maneuverability and turn performance of Chance Vought aircraft that would be superior above the 60,000 ft altitude, observers feel. Aircraft made its first flight last week.

The McDonnell fighter wings are swept back 45 deg. Aircraft carries pilot and radar observer (AW June 3, p. 31).

Powerplants are two General Electric J79 engines producing 10,000 lb thrust each, one tilting forward near turn takeoffs.

Engines inlet appear to be variable geometry type in which a hinged ramp adjusts diameter for maximum efficiency, similar to that used on Convair F-106. At higher altitudes, F4H-1 also is equipped with drag chute to slow landing roll.

These can be equipped with four Sparrow III air-to-air missiles and also a variety of long range delivery of conventional and nuclear bombs. Aircraft is said to have greatest range of any Navy jet fighter.

Refueling can be accomplished at supersonic speeds by probe and drogue or by buddy system.

The aircraft is 55 ft long, has a wing span of 35 ft 3 in.

J. S. McDonnell, president of McDonnell Aircraft, said 4,231 employees now are working on the F4H-1 project. He said 6,500 man-hours were expended on the design and construction of the initial aircraft before its first flight.

Decreasing the economies of McDonnell Aircraft's entry into the supersonic, oxygenated interceptor field, McDonnell said, is the shift of employment at the company would be dependent to a very considerable de-



SPARROW III missile, proximity control unit hangs on to nose in this F4H-1 carrying view.

pace on the Navy's acceptance of the phase for volume production."

F4H-1 Subcontractors

He stressed that approximately 1,500 subcontractors and suppliers from 25 states are involved in the F4H-1 program.

About 400 of these companies are located in the metropolitan St. Louis, Mo., area.

"The ability of our plants to deliver money almost is no longer dependent solely on speed, range or altitude capabilities," McDowell continued. "To

do the job better, our plants must be considered as part of a complete weapons system that also includes special radar, missile detection systems and guided missiles."

He referred to the advantage of radar operators in missile design and aimed.

"The fact that the F-4H-1 has two engines is critical to ensure a higher survival rate in training and combat operations."

F4H-1, he continued, is designed with a "liberal allowance for growth potential."

Kaman Laboratory Construction Starts

Bloomfield, Conn.—Kaman Aircraft Co. has broken ground for new engineering laboratory building which will be completed Sept. 1.

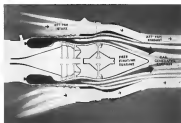
Laboratory, which costs \$4,600 sq ft of floor area is located near 11,000 sq ft engineering and administration building now under construction.

New laboratory is steel frame with concrete walls and two ribbed glass and steel roofs.



General Electric Tests Aft-Fan Turbojet Engine

Military version of General Electric Co's CJ601-21 afterburning turbojet engine is shown above being wheeled into test room. Engine is being tested for flight test on USAF jet trainers. It has undergone several months of testing at General Electric's Evendale, Ohio facility (AW May 25 p. 11). After the component flight, shown above, the engine will be tested in flight. The engine (right) shows free-flowing bar lines which show the flow, with only weak static connection between turbine and three turbine stages of the basic engine. Free-flowing turbine is supported by a bearing at each end of the shaft. Power turbine stages are supported by central shaft.



Hiller Assembling Prototype Tilt Wing X-18 for Air Force

Hiller Helicopters' prototype model of a 90° wing tilt aircraft is shown above. The aircraft will be designed to operate from bases near metropolitan centers. Tilt wing's versatility would permit conventional takeoffs and landings from conventional runways with excellent fuel savings. Below, Hiller constructs Air Force X-18 tilt wing research transport at Palo Alto, Calif. Tilt span of the forward wing section is at the top of the image. The wings will tilt at 90 degrees.



T53 Designed for Maintenance in Field

By Ervin J. Rubin

Steelhead, Conn.—Design of Lycoming's T53 800-shp turboshaft engine is aimed toward ruggedness at the expense of some weight saving as an attempt to provide reliability in the field where maintenance facilities and trained personnel may be available.

Practical considerations was given to the Army's reasons involving operations close to the battlefield.

These parameters resulted in the T53 having these basic features:

- **Compressor of axial-flow configuration** for the first five stages, plus a centrifugal impeller at the final stage. Also see for this, in addition to reducing the engine's weight, was to avoid high number of small stages and attendant multiplicity of small axial blades that Lycoming engineers felt would increase initial manufacturing costs and spare-parts availability and also be more costly to change design.

- **Coalescence of turbine exhaust gas** function also lowers the power turbine as part of the combustor assembly, providing short length. Quick removal possible can occur to all engine hot parts, reverse-flow design is aimed at even radial temperature distribution at the turbine inlet to increase life of turbine components.

- **Turbine output shaft** passes through the T53's hollow compressor shaft at lower reduction, gear and power output is placed at the cool front end of the engine. Short engine length aided this placement of the shaft.

Market Potential

Like General Electric which is planning a wide industrial market for its T58 (AW Mag 17, p. 52), Lycoming is studying numerous applications of the T53 for civilian and military use including ground power generation and in marine vehicles. Like the T58, the Lycoming engine is also being studied for use in Navy's new class of individual equipped high speed landing craft, in which several research contracts have been let.

Aircraft applications that are under development programs such as the Bell HU-1 (Hawkeye II-40), Kaman H-43B, Vercel 307 and Cessna's A-33 Mohawk turboprop, other installations include the D-40, X-16 ducted fan VTOL research aircraft, the Ryan Vertiplane vectored thrust VTOL, research plane and the Vercel 36 tilt wing VTOL. Two bed installations include the Kaman H-90K and Vercel 105 helicopters. Engine has completed a total of more 1,800 hr. of operating time.

with approximately 450 of these being flight time.

T53-L1 recently passed its 110-hr USAF qualification tests at 800-shp rating, an improvement over the 835 shp it was rated at prior to the test. This qualification test was of considerable importance to the Steelhead plant considering that USAF Army had earlier given it a production contract totaling approximately 540 engines calling for initial delivery of engines next January. Engines contracted for use included the Bell HU-1 and Kaman H-43B helicopters.

Lycoming production plans call for initial output of four or five T53s monthly; company expects to produce in excess of 500 engines by 1963 with production geared to approximately 50 T53s a month.

Cost Should Drop

This production quantity may bring cost of the engine down to \$55 per horsepower, further decreasing to approximately \$35 per horsepower in 1962.

In addition to the T53-L1 turboshaft, Lycoming is also working on a model for the turboprop version, designated T53-L3, slated to deliver a maximum output rated power of 960 shp plus 114 lb. reacted thrust for a total of 1,085 shp at 1,780 propeller shaft rpm and providing specific fuel consumption of .435 at rated power. Fuel specific is slightly improved over the T53-L1, which is given as .673 lb/whp/hr at military power. Its features include single and dual con configurations, the latter providing high takeoff power with advantage of being able to shut one engine down for up to two cruise characteristics for conventional military missions.

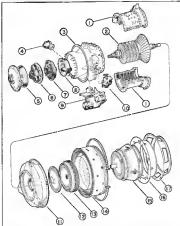
Lycoming is success developing the T53 turboshaft engine to more than 1,800 shp by increasing operating temperature; it also plans to develop the turboprop T53-L3 in stages. Current version, delivering 960 shp, could be boosted to 1,650 shp using new gear set arrangement and further power gain made in 1,235 shp by incorporating more turbine stages in compressor.

Also in the works is the larger T55-L1 delivering 1,675 shp at idling at 1,125 propeller shaft rpm and specific fuel consumption of .640 and a turboshaft version the T55-L3 with similar performance characteristics. T55 weight is about 680 lb. As yet Lycoming has not been able to develop sufficient data base without an engineering test more powerful than T53 is currently retaining as the test stand.

T53's axial-internal compressor designed to achieve pressure ratio of approximately 1.5, consists of five radial loading stages and low-bushings level non-cup blades for the initial stages fi-



AXIAL-CENTRIFUGAL COMPRESSOR is designed to keep number of blade stages and engine length to a minimum. Turbine output shaft passes through the compressor's hollow shaft to provide possibility of reduction gearing and power output at forward, cool area. Lycoming has plans to make centrifugal stage of turbine to reduce engine weight and acceleration time. Inlets, the pre-detonation region are shown in their final assembly stage at Steelhead plant.



RAPID MAKEUP of T53-L1 is in six segments in forward, cold section, start in hot section. Major components of preassembly include: 1. Shaft compressor housing and four vanes; 2. Compressor rotor assembly; 3. Air inlet housing; 4. Mass oil drive; 5. Power output gear assembly; 6. Turbine rotor and gear assembly; 7. Planetary gear assembly; 8. Accessory drive gear assembly; 9. Accessory drive gear box and oil pump assembly; 10. Chequerboard governor and turbine drive assembly; 11. Diffuser and fuel stage nozzle assembly; 12. Fueling turbine wheel; 13. Second stage nozzle assembly; 14. Combustion chamber assembly; 15. Power turbine support assembly; 16. Free shaft assembly and 17. Support cone assembly.



INTERNATIONAL DELINQUENCY

Nuclear weapons ready to be delivered by jets and missiles are vital. But in cases of international delinquency, they would be like city police using tanks to prevent a rumble by juvenile delinquents.

United States Navy carrier groups, like cops on their beats, protect our citizens, make rescues, and keep the neighborhood quiet. If called on, they can restore law and order with a wide choice of weapons from a complete arsenal. Carrier groups are also our best protection against submarines capable of launching missiles, plus being a deterrent to all-out aggression.



GRUMMAN AIRCRAFT ENGINEERING CORPORATION • Baltimore • Long Beach • New York



... new lightweight aircraft transformers withstand extreme shock and vibration

A line of rugged, lightweight transformers specifically designed for high acceleration, high-shock applications has been developed by Westinghouse Electric Corporation.

High resistance to extremes of pressure, vibration and shock makes these transformers ideal for many applications in both piston-powered and jet aircraft, as well as in high-thrust applications encountered just above missile-launching pads. Fitted with flame-fail cases, these new transformers have no pressure points to sell above 500-cycles vibration and are shock-tested at 50 g-mikes. They are completely insensitive to very high differentials of internal or external pressure.

Now in production at the Westinghouse Greenville Plant, these new transformers are available in ratings from 10 va through 5 kw, single-phase or three-phase, 400 cycles, 2500-volt test.

Contact your nearest Westinghouse representative for complete information on how this small, rugged unit can help solve your aircraft or missile transformer problem... or write Specialty Transformer Department, Westinghouse Electric Corporation, P.O. Box 253, Greenville, Pa.

YOU CAN BE SURE...IF IT'S **Westinghouse**



Ka-15 shows: 1—horizontal hinge, 2—vertical hinge, 3—axial hinge, 4—rotation damper, 5—axial hinge for horizontal hinge bearing, 6—pin for horizontal hinge, 7—axial hinge for axial hinge, 8—ball bearing for axial hinge, 9—blade pin, 10—thrust bearing for axial hinge.

Ka-15 for agricultural, multipurpose control and rescue work.

According to Kuznetsov, coaxial helicopters have better landing qualities and are more economical than single rotor designs. He adds that the coaxial craft can be built smaller and more symmetrically.

Pilot Training

Soviet helicopter engineer V. Bova points out that coaxial helicopters such as the Ka-15 have important advantages in pilot training. "Since the operators of these controls a closer to that of an airplane."

The Ka-15's lifting system consists of two identical rotors located one above the other on a single gearbox shaft.

Turning in opposite directions, the three-bladed rotors are fastened to one common shaft.

Power from the engine crankshaft is transmitted through an intermediate reducer to a distributing reduction gear. Two shafts come from the distributing rotating gear—a short, outer one for the lower rotor and a long, inner one for the upper rotor. The distributing reduction gear divides the power between the two rotors and produces their contra rotation.

The Ka-15's tail assembly, featuring twin fins and rudders, is similar to that of an airplane.

In general, Kuznetsov favors four-wheel landing gear for his coaxial craft to provide better stability while moving along the ground.

Control is Simple

According to Il'yuskin, control of a coaxial helicopter such as the Ka-15 is simpler than for a single-rotor helicopter.

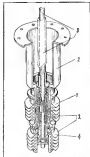
Main difference, he says, is in control (directional) control.

Longitudinal-lateral control (in cyclic pitch) for coaxial and single-rotor helicopters is similar. The only difference is that with coaxial helicopters, when the stick is moved in one direction there is no associated parallel tilt in the rotor disc as with single rotor disks.

"Collective pitch control on the Ka-15 affects all the blades of the upper and lower rotor simultaneously and in the same degree. The collective pitch and cyclic mechanisms operate exactly the same as on a single rotor helicopter."

"Course (directional) control with a coaxial helicopter such as the Ka-15 is achieved through pedal operation by two methods: its differential change, of the rotor collective pitch and by the rudders."

"Operation of all three control devices—cyclic pitch stick, collective pitch lever and pedals—is entirely independent.



COLLECTIVE and differential pitch mechanisms: 2—collective pitch drum, 3—fixed disc with main head shaft, 4—drum and cover for differential pitch, 5—transmission flange, 6—long control shaft.

rot. Piloting a coaxial helicopter is particularly simplified over the ground when there is a limited landing area containing obstacles. Thus, for example, it is considerably easier to land on a ship's deck or to fly between trees.

Il'yuskin says "the motion lag to stick operation in the Kuznetsov coaxial helicopter is less than for Soviet single rotor helicopters; and the control effectiveness is greater. Therefore, stick movement must be relatively less, and its return after movement in any direction must be quicker."

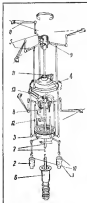
Range Increase

"The coaxial lifting system has other advantages. Because of the smaller loading on the disk of each rotor, when rotor loadings are equal an increase of about 15% in range and 20% in endurance is achieved."

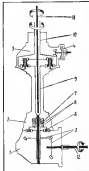
"Getting into turbulence or in faster rain vortices is also less dangerous with a coaxial helicopter."

Il'yuskin concluded that elimination of vibration is still a major problem on the Ka-15 and similar craft.

"The upper rotor is carried a long distance from the support on a connecting shaft and flexible shaft. It is, thus, susceptible to manufacturing discrepancies and vibrations which show up during the craft's operation. All portions of the coaxial rotor system



CONTROL rotors on coaxial: 1—quad for longitudinal control, 2—quad for lateral control, 3—three automatic switch plate, 4—upper collective switch plate, 5—bracket for mechanism for collective and differential pitch, 6—transmission shaft, 7—blade shaft, 8—upper disk, 9—lower disk, 10—pin for control shaft, 11—pin for blade pin, 12—lower disk hinge, 13—middle disk hinge. Arrows show direction of rotation of flaps of automatic devices and disks.



TRANSMISSION arrangement. 1-Meter reducing gear, 2-Combination clutch, 3-Clutch rotating member, 4-Rotor brake, 5-First gear, 6-Planetary reducer, 7-Fluctuator clutch, 8-Rotor brake, 9-Drive shaft, 10-Lower cone shaft, 11-E-type roller shaft, 12-Sprocket shaft drive.

is more complicated than is the case with a single-center system."

Dynalco also admitted that placing rotors one above the other "poses a danger that their blades will strike when they are turning at slow speeds or when they are hit by gusty winds while stopped."

This problem, he declared, can be minimized by close observation of operating instructions.

Thor IRBM School Opens at Tucson

Tucson-Douglas Aircraft's Tucson Municipal Airport facility has been formally opened as a Thor intermediate range ballistic missile school for USAF and Defense's Royal Air Force personnel.

Program represents a consolidation, at the request of command, of training activity which has been under way for some time at manufacturing facilities and other facilities.

Extensive programs in order contract to Douglas from USAF's Air Training Command.

Approximately 90% of enrollment will be RAF personnel. Both officers

and related men will comprise classes which will average 180 members. Upon completion of course, trainees will be assigned work assignments tailored at facilities provided to associate Thor contractors-General Motors' AC Spark Plug Division, Rockwell, and General Electric Co.

Science Conference Draws 480 Students

Los Angeles-West Coast Student Conference of the Institute of the Aeronautical Sciences held here recently drew some 480 scientists from colleges and universities, more than double the number of earlier years.

Eight endogenous and two graduate papers were presented at the conference with Texas A&M at Douglas State College winning in the undergraduate category for his paper on "An Experimental Verification of State Stability Predicted by Nonlinear Control Theory."

Molecular Luck, graduate student at California Institute of Technology won the graduate division for his paper on "Fluid Turbulence."

Graduates included plant two and biopack at which awards were made.

Wright Replacing Cap On Turbo-Compound

Heat resistant alloy steel cooling cap on the power section used of the Wright R390 Turbo-Compound engine has replaced the metal alloy cap formerly used.

Purpose of the change is to extend the service life of the cap, which serves to dissipate cooling air from the turbine section.

Power recovery section is a source of workload problems on the engine (AVR April 21, p. 39).

Contracted on R390 alloy steel, new cap is expected to withstand the 1,250°F exhaust gas temperatures for over 4,000 hr of service.

Caps are fabricated from R390 alloy tubing produced by the Alloy Tube Division of Carpenter Steel Co., Ulenia, N. J.

Reprints Available

Reprints of Aviation Week's special report on susceptibility/robustness at the following rates:

1.00 copies \$6 each each.
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Orders should be addressed to Aviation Week, Report Section, 130 West Glad St., New York 16 N. Y.



KEY ENGINEERING OPENINGS AT VOGHT

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Vought Design Engineers are working in extremely varied areas on missiles, manned aircraft and spacecraft. Problems range from design analysis for dynamic response to the problems of satisfactory environment for man in space. Following are key opportunities for creative designers:

Powerplant Installation Design (Missile). A.E. or M.E. with experience propeller specifications and layout. To design fuel, air induction and accessory systems, and engine mountings.

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Engine Arrangements, A.E., M.E., E.E. with experience in cockpit or aircraft design. Also valuable: industrial design or product development. To develop and design cockpit and crew stations for advanced aircraft.

To arrange for a personal interview, or for a complete report on these or other current openings, return complete for:

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Interested in the opening for: _____	
Name: _____	
Address: _____	
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Vought Vocabulary

re-lent'less: a missile that pierces hostile sky to pinpoint its nuclear strike

When a target's latitude and longitude are marked on this missile's nose, an appointment has been made.

To keep its rendezvous, the Chance Vought Rhapsody II performs maneuvers of consequence: it will launch itself half down subsonics—accelerate and decelerate—from surface craft and mobile shore launchers. It will compensate automatically for wind and weather and for the earth's rotation. It will deliver enemy strongpoints, outline known countermeasures. Closing in on its quarry, it can plummet from over 50,000 feet to attack-level height to escape radar detection.

In minutes, Rhapsody II can pierce over 1,000 miles of hostile sky to score a nuclear hit-off.

The first of the Navy's nuclear-driven subs, designed to roam the seas in unseen Rhapsody II noses, is now in construction. The missile itself has made over 25 successful flights. Under Navy leadership in key locations, it will be a silent threat to hostile shores.

Scientists and engineers, pioneers with Vought in new missile, manned aircraft, and electronics programs. For details on select openings write to: C. A. Beck, Supervisor, Engineering Personnel, Dept. M-10.

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techniques, such as Honeywell developed wiring program for ballast manufacturers, have made Honeywell a worldwide leader in the industry.

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**They offer greater accuracy at
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For over 15 years Honeywell has manufactured precision pressure transducers for use in Honeywell systems. These tried and proved components are now customarily available for the following applications: Jet Turbine Compressor, Altitude Control, Altimeter, Mach Control, Altitude Switching, Mach Switching, Altitude Switching, Mach Switching, Air Speed Computer, Pressure Ratio, Engine Inlet Control, Ramjet/Wall, Safety and Arming Controls, Underwater Pressure Sensing, Speed and Altitude gun charging.

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- Force resistor or direct drive
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- Accuracy—better than 1% can be provided.
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Honeywell currently has pressure transducer equipment flying in such aircraft as the F-89, F-100, F-101A, F-101B, B-58, B-36, B-56, CF-100, CF-105, KC-135, B-15, B-36 and various missiles and target drones.

For complete information on Honeywell Pressure Transducers write Honeywell, Military Products Group, 2000 Highway Road, Minneapolis 13, Minnesota.

Honeywell

 *Military Products Group*



SKIMMER IV takes, shed of making, sheds good stability. Wing area is 137 sq ft, including trapezoidal fins.

Ariston Week Pilot Report

Water-Stable Skimmer Lands 'Hands Off'

By Robert L. Strafield

Teterboro, N. J.—Excellent short field capabilities, along with extreme stability during water operations, are key features of Columbia Aircraft's new four-place G-2 Skimmer IV.

Amfibious amphibians are powered by Evening 0360-AIA engine generating 180 hp at 2,700 rpm, at takeoff. Engine compression ratio is 8.5 to 1. Fuel grade is 91 octane. Fuel pump is electrically forced dual, constant speed. Governor is Woodward.

Trim Difference

Engine location—above and behind leading edge of wing—results in trim change with application of power which is opposite to that encountered in conventional single-engine configuration.

Performance characteristics evidenced during flight evaluation by American Westair School.

• **Handoff handling.** Water landings are a much prevailing pilot doesn't try too hard. Actually, he must learn to

do nothing. Amphibious requires no abrupt back pressure. None won't dig and engine can take on more without trying. Skimmer was loaded "hands off" twice, did a five job all by itself.

• **Water stability.** Despite gross weight ranging from 20 to 40 lb, airplane was almost in trim like a boat. There were no water-sloping tendencies. Skid-boat float didn't add crosswind trim capabilities airplane won't tip in turn.

• **Short field performance.** One gearless electrically driven gear at 21.5 sq ft, extend 50% of the area of the wing. Result: good lift, plus cushioning effect on landing. Airplane flies off hard surface runway in slightly less than 100 ft., was brought to stop in 30 ft., and in slightly over 100 ft. Skimmer is loaded to operate on low-water areas. Obtains cruise altitude in less than 100 ft. Water operations are not recommended above this altitude because of power loss.

Thus, taking amphibious is rather deceptive sitting on the ramp, appearing smaller than its actual size. Side of fuselage (shown) is but 17 in. from ground. Wide gear track is 11 ft. 2 in. Gear, with long axle travel, is a combination of +130 steel.

Powerplant is fixed mounted with steel reinforcement providing engine. Flyline provides interconnect thrust strength and structural stiffness. External side braces provide for lateral loading.

Roll brake down rate from separate water skid-mounted compartment (both down flaps). Two of these being in use. Main gear down rate is 100 ft. Airplane's float hangers and wing tips are plastic. Can tank in fuselage aft of passenger compartment, can also be deployed in ditching down when empty or partially empty.

Amfibious float is N2558, first production model Skimmer IV which will not last September. Abundant Jack Striker president of Amphibious Aircraft Corp. Teterboro, warning organizations for Columbia Aircraft Co. With two standard plus instrumentation and navigation equipment, and 20

gal of gasoline, airplane powered out at about 1,800 ft. Maximum allowable gross is 2,150 lb.

Amfibious was entered through wind-shield "door." Windshield is hinged in center. Either half can be moved up and over until it lies on other half. With cabin open, one can stand straight up in cockpit and, if necessary, step to bow of airplane during water exit.

Cabin is roomy and comfortable. Floor is riding height is 47 in. at nose, 47 in. in front. Width is 44.5 in. Length is 62.5 in. Three back of rear seat to back of movable front seats, length is 39 in. Track at the rear of back seat will hold 10 lb. Extra cabin length could be increased to 82.5 in. by extending rear seat.

Accessories in bow can be easily reached. These include engine and cooling fans, battery, and instrument room; all in separate compartments.

Instrumentation and Controls

Skimmer's engine controls—throttle, pitch, mixture and carburetor heat—are located overhead, center, and are accessible from both seats. Flight instruments are located in front of pilot. Radio is center. Engine instruments are mounted to right.

Switches for lights, pitot and cabin heat, hydraulic pressure, generator, battery and engine light are set in dachage to pilot's left, along with control for mechanically activated water rudder. Circuit breaker can be reached without in addition to engine driven pump. Also fuel pump switch is available for starting, idle and backup.

Also center mounted just below instrument panel are gear and flap handles, telescoping emergency hydraulic pump, and gear flap indicator lights.

Spring-loaded hydraulic trim system control handle, which springs back to neutral after trim application, is located on floor between pilot's seats, in a parking brake lock.

Engine started up quickly and the surprise was heard out. There was a bit rough until it adjusted to a forced and positive backing action. Flakes are on pilot's side, engine's engine position for directional control only and can be added down back to those for additional leg room.

Lowering engine has a tendency to rise up through fuel and fuel indicator heat was needed. There is no prop block, but no positive configuration, and a low two speeds as that does not appear sufficient.

Magazines were checked and prop was through at 1,800 rpm. Fuel flow was stopped (there is only one fuel tank), corrective heat was moved to cold, and airplane was ready to go. Water was from the northwest at 20



G-2 pos. with long axle track, is without of +130 steel, track is 11 ft. 2 in.



AMPHIBIOUS float hangers and wing tips are plastic, interlock with in holes.



RINGED and ventrally windshield folds over from other side, few accessories are within easy reach. Cabin is 47 in. high, 44.5 in. wide and 62.5 in. long.

Colonial C-2 Skimmer IV Specifications

Engine	Lycoming 0660 A1A
Hp and rpm	150 at 2,700
Propeller	
...Blended tapered disc, constant speed	
Empty weight (lb.)	2,570
Gross weight (lb.)	3,515
Useful load (lb.)	945
Wing span (ft.)	34
Wing area (sq. ft. including flaps)	197
Length (ft.)	23.6
Height (ft.)	10.3
Wing loading (lb. sq. ft.)	35
Power loading (lb./hp)	15.1
Flap span (sq. ft.)	24.5
Flap area (sq. ft.)	17.1
Stall speed (mph)	24.5
Flap speed (mph)	27.5
Rudder area (sq. ft.)	5.4
True surface area (sq. ft.)	3.75
Flap capacity (gal./hr. actual)	40
Baggage capacity (lb.)	30

Skimmer Performance

Max. cruise speed (mph)	100
Normal cruise speed, 75% power (mph)	125
Stalling speed (mph)	51
Rate of climb speed, flaps down (mph)	71
Rate of climb speed, flaps up (mph)	90
Rate of climb (ft./min.)	500
Climbing speed (mph)	100
Fuel consumption (25% power)	
mpg	9
Optimum cruise altitude (ft.)	6,000
Service ceiling (ft.)	14,000

ft. with gear up to 80. Sea level pressure was 10.05 in. Outside air temperature was 60°.

Once Skimmer started to roll it had immediate directional control as banking was necessary. Airplane picked up speed quickly and was airborne with slight back pressure at 65 mph. Take off run was less than 400 ft. pulling 27 in. manifold pressure and 2,700 rpm.

With gear up, power was reduced to 25 in and 2,600 rpm. Amphibians ran half to initial climb speed of 75 mph. Flaps were raised with no appreciable stall, and airplane climbed out at 90 mph. Rate of climb was 1,000 fpm.

During climb Skimmer was ditchcraft, gulfed nose high. Strepent presents no hazard and it wouldn't be easy to stall after takeoff. With banking and very turning instead of flat. Flight path indicator, nose was canted forward and climb out continued.

Carburetor well ahead of the wing, and big windshield nose makes for good turns ahead, to the side and down, and left. Turning around 1 mile ahead

into, inversion of horizontal turn surface. Stability was good during climb and the airplane responded quickly to light control pressure. Skimmer requires minimum amount of elevator control.

With engine high and to the rear of cockpit, over correction was possible, nose level was moderate.

Amphibian was leveled off at 2,000 ft. and headed for nearby Malibu Beach. At this altitude, with 75% power—245 in. and 2,400 rpm—indicated air speed was 125 mph. Approaching the beach engine-out procedure was simulated.

Power cut out, back full carburetor heat applied, and full flaps dropped. Lowering nose, then was set and Skimmer spooled down at 81-90 mph. Approach wasn't too steep and control was good. Approach was held on high rate because of strong gusts.

Amphibian was held off over water until ready to stall in. Controls were released and 1 simply sat back. Skimmer, with big flap area, seemed to have slightly better dropping in. Water was somewhat choppy and windblast caught a bit of spray, but there was no digging of hull nor was there any bounce involved. No lock pressure is necessary.

Propeller air high enough to be immune from water spray, as well as ground, stones, etc., pulled up on runway. Height, plus protection of wing and dorsal prop and engine from air spray.

Maneuvering with water rudder down is easy, as the amphibian won't

tip running crosswind. Best hull holds well in water and wing flaps have good balancing effect. Skimmer has been flown off to several runs, but with heavy gusts and chance of striking a snag at pull-off, the maneuver was postponed.

Additional safety feature in water operations is nose wheel, which with bar running ahead of nose bar up position acts as buffer. Gear was designed to take shock. It is lowered in the water for run in and up about wheel recesses. Common, which is a salt water problem, is offset by extensive grease fittings.

With but slight back pressure, Skimmer then stilled off water. Elevator control provides good longitudinal control at low landing speed on water. Amphibians will usually get off at 65 mph. With a little backstroke to hold nose out, then forward, the airplane went off at 70 mph. After a short run. Again, because of gusts, speed was held higher than normal.

Almost all water landings were short, all with good results. Skimmer has even been landed in water with gear down. Amphibian didn't turn over because of main gear's backward position, plus location of fuselage axis (forward) ahead of wheels.

Still Characteristics

Skimmer was stalled power on and power off with gear and flaps down. With the engine pulling 24.75 in and 2,400 rpm, the nose was up fairly high before pre-stall buffet and stall were encountered.

Still nose at about 10 mph but



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radar-equipped • reserved seats
spacious lounge • superb cuisine
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Converted Navion Cruises at 185 Mph.

Navion conversion developed by Tacon Corp., Houston, Tex., features 240 hp Continental engine, McCauley constant-speed propeller, 34 gal. oil tank, wing-to-body struts, fixed control wings. Tacon reports that its new Model D Navion has maximum cruise speed of 185 mph and climbs at 1,010 fpm at 2,000 lb. gross weight. Gross weight service ceiling is 17,400 ft. CA-converted Model D also provides entrance to cockpit over wing leading edge, a step-ladder provided in the wing door. Floor has rails arranged to act as guide rails.



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RELIABILITY or

The Wonderful One-Hoss Shay

A Logical Story

Have you heard of the wonderful one-hoss shay?
That was built in such a logical way
It ran a hundred years to a day?

"For," said the Deacon, "It's mighty plain
That the weakest place must stand the strain;
And the way to build it is only jest
To make that place as strong as the rest."

The Deacon followed the two cardinal principles for reliability.

1. Know the stresses your component will be subject to (in other words know the environment).
2. Build faithfully to the specifications that cope with this environment.

At CPPEC we feel one of our great assets is careful manufacture by a skilled and conscientious crew.

Reprints of the complete, original poem—
The Deacon's Mystery or The Wonderful One-Hoss
Shay by Oliver Wendell Holmes sent upon request.

LOOK TO CPPEC FOR SYNCHRO



PROGRESS

CLIFTON PRECISION PRODUCTS COMPANY, INC.
Clifton Heights Pennsylvania

there was no clear head, and fell away after a combination of buffeting, lowering which caused when more was lowered and speed increased. Although the wind and lateral control good.

Powerful still, according to specifications, could reach in less of 250 ft. With flap and gear down, still again was provided by buffeting and still across which provided break by 7 to 10 mph. Head was smooth at 50 mph and altitude loss was negligible. Low stalling speed is attributed to large, slatted flaps.

Stability and control of Steiner were excellent during all flight phases. Elevator control in a weather at light speeds, explained because of powerful trim requirements, employs separate set of longitudinal control surfaces.

Control system, without any manual control, is pushed into with the exception of a short length of chain and cable in the altimeter system of the control wheels. Longitudinal trim surfaces are individually controlled. Trim system is 15 in. in, in very limited amount of control surface on elevator and prevents overcontrolling.

Steiner was next flown through several hard-surface landings, with time out for additional practice.

Fuel Consumption

Amphibian averages 9 gal. per hr. fuel consumption. With 44 gal. of fuel, this would allow 4 hr. of cruise and return of about 35 mi. Range, at normal cruise of 125 mph, would approximate 500 mi. plus reserve.

Altitude is achieved at 146 mph. Cruise and dip speed is 125 mph. With gear and flap down, and landing 90 mph on approach, rate of descent can be held steep with power off. Carrying into a tight one wouldn't be hard.

Rate loadings were slow. Amphibian was low, and there is a tendency to level off too high. Amphibian will cushion itself down after touchdown and it used no more than 400 ft. of runway.

Short-field landing, as mentioned earlier, was made at about 100 ft. into 50 ft. wind with prop in flat pitch. Steiner demonstrated this one. Descent was steep enough to override natural obstacles and airplane attitude quickly after touchdown. Only moderate landing was necessary.

Steiner's attitude system is based on direct to keep hydraulic fluid out of engine compartment. Acceleration provides rapid rotation of arm. Electric pump changes acceleration up to 1100 psi, at which point the electric motor is stopped by pressure switch. When gear, flap or longitudinal trim surfaces (also individually controlled) are, upended and pressure drops below 750 psi, the electric pump automatically starts and recharges the accumulator.

Electrical system is a single-forward 120-volt, constant breaker protected. Ball structure consists essentially of upper and lower longitudinal and lateral struts and fuselage and side wings. Aluminum alloy (24 ST) is used almost exclusively for spar, ribs, frames and external covering. Ball also is 90% copper. Corrosion protection is via zinc die treatment and zinc chromate priming of all aluminum parts prior to assembly.

Wing lift loading is caused by a single spar at the 55% chord point.

Lower portion of the beam is built up with 14 ST extruded spar caps and 24 ST web. Outer portion is a 24 ST built up channel section.

Two fuel, quantity, vent under each wing, are located in main wing spar. Chordwise bending strength is provided by an additional spar along the trailing edge of the wing. Central inboard section of a beam is provided bending strength, with airtight water seal providing required torsional rigidity.

Large trapezoidal wing fence appears like old to Steiner's trim appa-



Bethlehem Steel Convoys Get Longer Range

Bethlehem Steel Corp.'s two Convoys 440 electric transport have been assigned by Pacific Northwest Corp. to provide intercontinental range. Standard Convoys integral wing tanks were extended by a post-bulkhead between the farthest outboard wing ribs and the wing by pumping inboard in fuel systems from 3,750 psi to 2,500 psi. Bethlehem oil tanks were increased by 6 psi each to 36 psi. Flares arrived at Pacific Northwest from except for cockpit, Pacific Northwest applied Lockheed structural strengthening, building plywood molds to contain the liquid until it hardened. Lockheeds was forced safety pressure through holes drilled as pressure built. Quarter-mile problem was corrected to reduce main stress. Modification company first tried several average speed reduction of 20 degrees through with standard Convoys manufacturing. Flow stream was modified to take speed in real time and design. Bethlehem's 440s can now run up to 23 percent each. Photos on Steel with Reader RXD-1B-1 X-band weather radio.

also. Tolls are necessitated because of negative pressure conditions induced by propeller intake.

Basic price of Skimmer is \$21,750. Standard equipment includes stall warning indicator, basic flight instruments plus auxiliary position gage, attitude indicator and rate of climb, turn, pitch and yaw, and four air vents for each of the cabin windows.

Optional equipment embraces dual controls, specialized instruments, radio equipment, heater, bow landing lights and electrically heated pitot. Latest maintenance package deal is in the works to set a complete package at \$2,900, with an extra \$2,900 for necessary equipment.

Colonel Signer said that with five-year depreciation, insurance, hangar rent, direct operating costs and an easily handled but anticipated maintenance plan on gas and propeller overhaul, Skimmer IV can be operated for less than \$87 per hour if utilized 600 hours per year. Operating costs for two persons, are estimated at 74 per passenger mile. C-1 was certified by the CAA on Dec. 18, 1967. Golden now flies in January and the third and fourth airplanes were delivered last month. First orders total 36, with next delivery scheduled for mid-September. Company is working toward minimum three-month backlog of 10-12 airplanes.

By November of 1967 the firm hopes to be turning out 17 aircraft a month—roughly 780 a year. Skimmer dealers in the U.S. now number eight. Amphibia can Assembly plans to add seven more for a total of 15. Top markets for the amphibian are low-altitude water areas in the U.S., Central and South America. In addition to sportman and executive use, Amphibia Aircraft is not discounting explorer's applicability for all three of continents.

Earlier three plans: C-3 Skipper, of which 25 aircraft were sold between September, 1966 and August, 1967, probably will be discontinued in favor of the C-2 Skimmer IV.

PRIVATE LINES

Kohlers Aviation Corp. has been formed as result of reorganization of former Executive Aircraft Corp., Pontiac, Mich. Firm holds Licensing and Aero Commander distributorships. New offices and fully-equipped repair facilities are being built.

Junior Jetco unit, developed by Aerojet General, delivering 710 lb. thrust for additional takeoff power, has been tested on aircraft engine type certificate by Civil Aeronautics Administration. Unit, designed for single or multiple installations in series of up to 10,000 lb. gross weight, delivers equivalent of 180 hp for 15 sec. duration, single about 30 lb. installed.

Booth Aircraft Corp. has been awarded a \$1 million contract from USAF for additional 470A tactical wing assemblies, extending the production through spring of 1970.

Wing-mounted shop installation, built by Raymond Aircraft, Inc., Dallas, Tex., on 280 hp. supercharger 567 DGC-3 has one day, first capacity. Designed on basis of service and time studies, units per cent of needed shop facilities close to the job have been installed at 49 St. Louis, Toledo and Pompano Beach bases.

Number of airports in New York State, increased by 13 in 1957 to a total of 277 landing facilities. Department of Commerce reports. Latest list shows 46 unimproved fields, 174 private and commercial fields (up 13 over previous year), 11 military air bases, 57 seaplane bases and seven heliports (three less than in 1956).

Bureau of Reclamation of Department of Interior has taken delivery of its Aero Commander, a Model 658 Super, which is fitted for aerial photo work. Based in Denver, Colo., the plane will be operated from short fields, adapt to dam and power plants.



"Environmental Testing" A Carburetor

When the densest that heavy steel door, an Airwork overhead carburetor will fly 10,000 feet above sea level. A few feet away, the piston will tell exactly how well it would lead an engine at this altitude. The inspector will compare fuel flow and air flow with the sea level performance determined by previous tests.

The test is part of an air circuit and bleed test stand that simulates altitudes to 20,000 feet. Airwork uses

it to performance test engines at all these altitudes where most of their working life will be spent.

This extra test—and the extra equipment needed for it—are typical of Airwork thoroughness. We make sure, before the unit leaves the shop, that it can be trusted to deliver top performance.

How far yourself, the big difference quality makes. Send your next engine to Airwork. You'll be glad you did.

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De Havilland DHC-3 Otter series is a flying tested by a model of the de Havilland DHC-4 Caribou utility aircraft.

Twin-Engine Caribou Undergoes Testing

First prototype of the DHC-4 Caribou twin-engine utility aircraft is being fabricated by de Havilland Aircraft of Canada Ltd. at Downsview, Ontario (below). Second prototype is expected to be rolled out in next month. Five orders have been placed by the U.S. Army for the Caribou. Model at right is potential in Army also built. Model at right looks, in general, as white and a two-engine utility, a utility considered the Army is using an aircraft flown in Arctic as tropical regions. U.S. Army Caribou will have Pratt & Whitney R1190-4 engines producing 1,450 hp, at 2,700 rpm for takeoff. Planned will be between 1,000 and 1,350 hp.



Industry Team Bids on USAF Project

By Craig Lewis

Dallas—Weapon system group has been formed by Texas Aircraft Corp. and other companies here to prepare a bid on a complex weather reconnaissance system planned by the Air Force. Formation of the group points up some changes in the technical and management setup in the service industry.

Texas group is the latest sign in a trend toward group efforts on weapon system line observed in *Airpower* Week a year ago (May 6, 1957, p. 68). And it's a trend that has strong support from the Air Force.

For the companies involved, these team efforts mean a chance to provide a complete package for the customer, to be big and complex for them to handle themselves. Benefits don't extend to the smaller companies. Convair's of aircraft industry giant bidding on the Dynafire project show that for the Air Force, these teams mean more economical use of industry facilities and capabilities and less money spent on building new facilities and developing new technical skills when those skills already exist.

With the group effort, new combinations of skills needed can be brought in rather than the team is being formed. This cuts into the former position of developing needed new skills at USAF cost in single companies working on complex systems.

USAF has supported this in various ways. Dec was a letter to Aircraft Industries from Maj. Gen. William T. Thorne, Deputy Director of Procurement and Production. In this letter, which was distributed to the industry, Thorne observed that growing complexity of weapon systems will increasingly require proposals from system managers and subcontractors combinations from the aviation, propulsion, electronics and allied industries.

General Thorne said that "it would appear that such prime contractor-subcontractor combinations could offer the possibility of developing superior products with a more economical use of existing industrial and engineering resources. Furthermore, this should reduce requirements for establishing new facilities and developing engineering capabilities when development requires resources in other companies."

Thorne also had done a unique recent challenge. He pointed out that one of the big problems with these combinations lies in the integration of management efforts in a way which gives all the advantages of the team approach, yet retains the essential single point of responsibility of the weapon system manager.

The development of management concepts and procedures which will address these objectives should be a major challenge to the aircraft and allied industries, he said.

It appears certain that the management capabilities of bidding groups will be increasingly important factors in the awarding of contracts for major systems. Not only will companies have to prepare the best technical solution to a weapon system problem, but they will have to show that they have the plan and skills to make a success of managing the weapon system program even then, get it.

To prepare a bid for the new USAF weather reconnaissance system in this climate, Texas has formed a weapon system group with Northern Electronics Inc., Houston; Electronic Communications Inc., American Institute for Research, Goodrich Aircraft Corp. and Aerospace Development Corp.

The system this group is working on represents a unique, integrated approach to weather forecasting and research that nothing now used. It is "a gross extension of the state of the art" in the words of E. Norman Palmer, senior vice president of Texas.

Palmer will operate in a large two aircraft of a current type one that will fly at speeds to Mach 95 and altitudes to 50,000 ft. No engine is specified but it is obvious in the Boeing 707 or Douglas DC-8 class. The system is to be made in the 705-73 ground and has to be compatible with other states of the art in those areas.

Date Transmission

Operations will involve such time bases as meteorology, geophysical observations, use of radar for searching clouds and storm centers, microwave capability and data gathering, timing and processing. Also involved are the problems of the transmission of data from high speed aircraft over long distances and the logistics of operating such a reconnaissance system.

Weather reconnaissance system will be designed for operation under all conditions, be individually sophisticated system. It involves ground stations as well as a flying system and it may involve the whole cycle of orbital and modification as that system could be made by the people who designed and built the system.

The system will be used as a world wide weather reconnaissance operation operating on a global principle. Information is to be transmitted to ground stations all over the world. United Nations currently sponsors a group—World Meteorological Organization—which pro-



Convair Assembles F-106 All-Weather Interceptors

Convair Division of General Dynamics Corp. assembles F-106 interceptors for USAF's Air Defense Command. See *Design* 100-19. Week-end one complete F-106's. Two-week F-106's month. Made first flight at Edwards AFB, Calif. (AV April 21, p. 15)

vide the exchange of weather data and the USAF network would be compatible with the international system.

In contrast to present techniques of weather forecasting, which happens to weather the reconnaissance system would find its information is sent prior to find out something about it to get a forecast, more basic pattern. The system could have weather research at high altitudes along with simple forecasting.

The association back toward the late forties in weather reconnaissance is made possible by advances in computer art in recent years.

Unlike such projects as nuclear systems, the industrial discipline for the weather system can't be too strictly defined.

The fact gives the contractor more flexibility and more responsibility in design and development work.

In case war, the weapon system group Texas and its associates have devised a number to the current weapon system manager concept, but it exists as a team also a major factor in having the team work together from the start rather than forming it after the project

contractor system manager is awarded a contract.

The approach gives Texas the benefit of industry wide skills and a broader view of the situation. It also provides the technical competence and broad ground forces will be used in the contract. About half of the system contract without the need for expanding into new areas. And the advantages are not as technical. The financial concepts of such power firms as Convair, Cutler-Wright, MacPherson Development Corp. and North American Corp. (Northern Electronics) add to the state of the art in the project.

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Navy's Anti-Submarine Version of Electra

Model shows configuration of Navy anti-submarine warfare version of the Lockheed Electra. Bids under review for the new modification. Plans for new would have magnetic anomaly detector (MAD). Aircraft would carry crew of two. Lockheed has a \$1 million contract for research and development prior to production of the aircraft.

of large company structures and gives USAF an organization that can move quickly, yet has the resources of large company machinery.

These agreements coincide with Air Force thinking as cited in the Thomson letter and elsewhere. Different manifestations of this can be seen in USAF efforts to blend skills in the research field, either through new, very new. Aviation Week has noted the recent trend to merge in the field (including such moves as the formation of a new company, Aerochem, by North American Aerospace and Phillips Petroleum [AW April 16, p. 5]).

The process of forming a combine like the Tocco group is also considerable intercompany integration and synthesis. Documenting the opportunity of the force involved, members of the group and "we protect their secrets here." Complete knowledge and understanding of each other are essential in the decision to share such company secrets quickly in its area.

After choosing a number of firms in the process, here are the companies the Tocco group would use with the functions they will perform:

- **Goodhue** provides radar capability for reconnaissance of clouds and storm centers. Company has capability in a specialized field of radar that applies to the weather system.

- **Katharine Inc.**, is in the field of digital computers and provides and provides capability in information theory and data processing for airborne systems.

- **Aerometrics Development** will work on the flexible, automatic test and checkout gear which will be needed to make in-flight checks of system components and to make automatic decisions on the equipment tested.

- **Northrup** Electronic specialists in sensors and measurement instruments and will provide capability for measuring meteorological and geophysical conditions.

- **Electronic Communications** will work on the problem of data transmission in a ground network which will provide data in a suitable form for weather observation.

- **American Institute for Research** will handle the human factors problems involved in the operation of a complex system.

Group members have had to submit competitive proposals in some areas in the case where capabilities overlap. One company does the job, and the other firm is located to backup support.

Group has been working together at Tocco since April under terms of an interim agreement. The agreement specifies that Tocco is responsible for engineering and scheduling the group and that the associates are responsible for developing their selected areas of the proposal and for providing Tocco

with management, technical and cost data related to these areas. Each company is giving an open exposure in the group chart, and each largely, are visible to the people involved. Provision is made for Tocco to pay Northern and American Institute for Research for special help in connection with Tocco's data of the responsibility.

Agreement calls for free exchange of proprietary information, but limits use of such information to the current project. If a suitable idea is developed to a practical degree during the job project, it remains the property of the participating inventor, but other members of the group get non-exclusive, non-transferable license to use the invention as a result here.

A Policy and Program Committee has been established with Tocco as chairman and includes one management representative from each associate. Committee reviews the bid effort and can make recommendations to Tocco in the field of the project, proposal and negotiation with USAF.

Yoho Power

Pdls, has been joined on any suggestion made by the committee in Tocco, but a dissatisfied associate can take the chairman's decision reviewed by two officers of Tocco after two falls.

Provision is made for withdrawal of an associate in extreme circumstances. If one of the associates wants to leave the group, it can proceed in two. Then if Tocco top management and two thirds of the associates consent, the first can withdraw under terms dictated by Tocco. These terms are not to include any form of payment of conceptual design.

The group also can eliminate one of its members under the agreement. After full discussion of the situation among Tocco, the committee and the associate, the decision rests with Tocco. No claim for damage is allowed under the termination can be proved dependent on in bad faith.

If an associate leaves voluntarily or involuntarily while the Tocco bid is still in competition, the associate cannot join a competing group or divulge any information concerning the Tocco project. Tocco decides who will do the job left to be a withdrawing associate, and provision is made for covering new associates.

The interim agreement covers the period of bid activity and negotiation with USAF until a decision is made. If the Tocco group gets the contract, the management moves to build a more complete working group to manage the contract.

If a contract is awarded, Tocco will be the central agent which has the right to the Air Force and will be the prime contractor. At this point, each

associate will negotiate a subcontract with Tocco covering its own area of the reconnaissance mission. Tocco is the joint efforts among the associates then becomes the result of two bid between them, rather than a responsibility set down as it is in the interim agreement.

The Policy and Program Committee will continue throughout the duration of both a prime contract, although provision is made for its modification or deletion in new circumstances.

Formation of the weapon system group for the aerial reconnaissance system reflects Tocco's description to award the aerial reconnaissance field as an act of specialization. The company has produced an aerial reconnaissance system for the Navy and has built up a quick reaction capability in its aerial reconnaissance program.

This quick reaction capability is today doing a fast job of putting electronic systems into modified aircraft and training the operators. In cooperation with this, Tocco built an antenna laboratory and developed a capability in that field. All these moves helped Tocco in the direction of aerial reconnaissance skills and the current competition.

Tocco has also been actively involved in building an engineering and management organization. In 1954, the firm started to build up a weapon system engineering staff. This began with the T.T.T., X-107 and Co. and continues for Tocco, proving itself as an effective vehicle for obtaining contracts.

A more sophisticated organization was needed for managing the contracts after they had been won, so the engineering department was reorganized along program management lines and Gen. Robert E. Gale USAF (R&T), was brought in to manage Co. and other programs. General Gale had been Director of the Combat Models Division of the Navy Bureau of Aeronautics.

In May, Tocco took a further step in this direction when it promoted Pdls from vice president engineering to senior vice president and named General Gale to the engineering vice presidency.

Contract

American Machine & Foundry Co. is producer of the launchers for B-57 Bomber's surface-to-air missile. On page 55 in the May 25 issue of Aviation Week, American Co. & Franklin was incorrectly named bidder of the B-57 missile.

American Machine & Foundry, in addition to the B-57 missile, also makes the launchers for the Talon, Navy surface-to-air missile.

NEW AVIATION PRODUCTS



Helicopter Spark Plug

Helicopter spark plug now available for commercial use has been in operation with USAF for the past year. Plug was specifically developed for Franklin-powered engines used in Bell, Hiller and Cessna helicopters.

The RHE-350 plug follows massive electrode design adopted in USAF. Approved for commercial use by the main character of Franklin-powered engines and the CAA, it is available through dealers.

Champion Spark Plug Co., Toledo 1, Ohio.

Seraph Microscope

Seraph, an optical microscope is used for checking surface on inside surfaces, aircraft nacelles, propeller blades and wing doors.

Portable instrument measures variations up to .001 in diameter in flat or curved surfaces to an accuracy of .0001 in.



Charles Evans, West Hartford 1, Conn.



Accessory Gear Box

Universal type aircraft accessory gear box operates in a horizontal position on either side of the engine.

Model 1125 gear box is rated to operate at a maximum altitude of 75,000 ft. Design life is 1,000 hrs with maximum ambient temperatures to 240° F. that is comparable to self-contained lubrication system with sight level glass for left or right hand operation. Input pin can turn to MIL and 10182 Type XII J. Output pin conforms to MIL and 20082 Type XII J. Designed for use of MIL-7795-C lubricant, seal has a lubricant service interval of 250 hrs. Weight is 14.75 lbs.

Western Gear Corp., P.O. Box 182, Lodiwood, Calif.



which detects lightning to control detectors (50 mi) but does not show charge buildup. Unit is available in several versions.

Metrodome Research, Inc., 959 E. Union St., Pasadena, Calif.

Air Quat Drain Valve

Valve automatically closes modes vs. to drain from pressure at drain. Valve is placed in drain system where condensation tends to collect. When system is pressurized the valve is automatically closed, unpressurized, valve opens allowing accumulated condensate

600 in. Cessna instrument is available which permits the reading of photographic counts on 15 mm film.

Kings Equipment Co., 411 S. Dearborn St., Chicago 5, Ill.

Lighting Warning System

Lighting detecting system warns cockpit and aircraft flight system and other lighting endangered workers of potential lightning danger.

System interprets atmospheric potential gradient according to its electric field. Coulomb meter shows buildup of charges between 20 mv. and indicates lightning discharges. Unit consists of an all-aluminum substrate plate for padding up an antenna, a shield, a detector with a variable logarithmic scale, and a recorder. System also includes a "flash" (radio static type) lightning indicator and

to detect out. Spring-loaded trigger mechanism will remain closed under normal static pressure and opens when first pressure is reduced to from 2 to 16 psi. Valve body is made of stainless steel.

Borden-Coleman Co., Aircraft Control Division, Rockford, Ill.

J.B.
Lycoming T53-L1 has successfully
passed its 150 hour qualification test.
No penalties either! It is the only gas
turbine in its power class to be
qualified and in production!

Bill - ↑
 Call Bridgeport, Conn.
 DR 8-0491 today!
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Lycoming T53-L1 560 shp., military rating
 developed under the Sponsorship
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Lycoming

A Division of **Avco** Manufacturing Company
 Stratford, Conn., Bridgeport, Pa.

Veronick. The other members of the crew were D. J. Hanes, steward, and Miss D. M. Newman, stewardess.

Three more T-28s were on board to police with their propellers and a small quantity of cargo. The aircraft was loaded and trimmed within the specified limits set out in the Certificate of Airworthiness.

DESCRIPTION OF ACCIDENT

At about 1314 hr on March 16, 1957, the aircraft on its way to Bangor, Bangor, passed into the control of the Vancouver approach controller. At 1316 the approach controller issued a call from the pilot and said he was going to O'Hare, Bangor, and reaching 5500 ft.

The approach controller then gave him the latest weather observations—wind 110 deg, 15 kt, visibility 10 miles, cloud 1100 to 1500 ft and 2100 ft at 10000 ft. He also gave the report position. At 1318 the aircraft reported at O'Hare Bangor and at 1320 he was at O'Hare Bangor. The pilot could start his landing drifts after passing O'Hare Bangor and this would be done before the flap.

The approach controller asked the pilot if he wanted an instrument landing. The pilot said he would like GCA to go down a short break. The approach controller said he would be in the control of GCA and approach to be used in as to cause a clear descent path, leaving him to make a final approach after he had broken through the lower cloud.

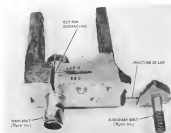
He was suddenly brought to the GCA controller and he came below cloud and had the aircraft to right, where he asked to be descended to the report controller. The pilot then gave a call saying "Ready" to that he was in line of approach to the runway as a position. From which a landing would be made on his first attempt. The report controller told him to see him to land and give him the runway end.

The approach controller said the aircraft when it was 41 to 1 on from the runway and the approach controller 41 to 4 on. Both aircraft in approach (thrust) were working at continuously and neither was working around mid if one, they thought about one mile or a little over from the end of the runway.

These last two at take a gradual turn (one of them described it as a "dribble" from 1 to the right, which looked like an instrument runway) perhaps to get into line with the runway, but very close to the runway and the sight of the bank continued on that both these witnesses noticed that something was wrong and took separately give the crash alarm.

Neither saw the actual crash because there was no observed by witnesses. The time of the crash was 1346. The first witness the day looking into and the crash was situated at something between 18 second and half a minute. The report at the current time is estimated at 115 to 120 ft.

There were no witnesses apart from the two control officers. All of them had worked in the neighborhood and were familiar with the sight and sounds of an aircraft running in to land. Two of them in addition were at the airport. One was a pilot in the A-1F from 1949 to 1946, and the other, Mr. Pettinger, had



BOTTOM View of No. 2 flap area is shown in this photograph. Investigators and Vincent crashed after big bank angle and 5500 ft. both broke because of fatigue.

had experience in the A-1C and as an observer at Farnborough and held a pilot's license, but no other details at present of what they observed.

The evidence of the witnesses did not exactly tally in all respects but there was general agreement that the aircraft was approaching smoothly through propeller arcs; that most and perhaps on a heading which would have brought it rather to the left of the runway. It reached a point about a mile from the threshold. It then banked to the right and maintained the bank for a short time.

Mr. Stankard found a sub-merged and looked in it if it was getting into difficulties but then got on his left radio and got on to an engine. No other witness observed this. It then saw an engine at a small distance and saw it as a small engine at a small distance and saw it as a small engine at a small distance.

The witness, Mr. Stankard, said that the aircraft appeared to pass straight through the clouds but then a crash-like sound was heard. It was then a crash-like sound was heard. It was then a crash-like sound was heard.

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5510 ft from where the wing tip first touched the ground.

Very important parts of evidence were given by Mr. Pettinger. He said that when the aircraft was in a point which is not less than a mile from the threshold and was getting into it. He said he could see it from directly above and observed that the two inboard main-lift flaps appeared to rise above the wing. It appeared to him that the aircraft had broken these flaps but could not see the wing.

One moment the flap was moved and the next time, one bank. The angle of the flap bank of the flap was then seen. One the trailing edge of the wing giving a sort of tail effect. The flap bank to control control. It was immediately after the movement of the inboard flap that the aircraft banked to the right. He looked to see if the aircraft could be controlled but could not see the wing.

I am satisfied that Mr. Pettinger's clear vision of the movement of the flaps was accurate and, although it cannot be certain that he could have noticed any movement of the aircraft if they had not broken because they are much smaller than the flaps, it was at first he said there is no evidence that was more than that the witness was appeared at all after the first turning and landing movement began.

Mr. Pettinger said that the crash occurred between the landing of the flap and the final impact with the ground at only about five or six seconds. From the evidence of other witnesses I think that this is an aside estimate and that the period was probably about 20 sec.

It will appear later in this report a more detailed description of the accident as Mr. Pettinger would need to cause the aircraft to make a landing turn to the right but not in such an event for the aircraft could not be made necessary in the situation of this case which would have been with experience in the control of

NEW ICEFOIL

Meets requirements of MIL-D-8181 plus 2000 cps @ 15G
Vibration Test plus 1450 ft.-lb. Ice-Ball Impact Test

The new AeroProducts ICEFOIL is specially designed for installation in the intake duct of gas turbine engines. Combining simplicity of design with minimum weight and maximum strength, the ICEFOIL offers a truly modern ice detection system for jet-air military and commercial aircraft.

In standard NACA aerofl shape cuts drag and air turbulence to a minimum. Its positive/positive pressure system provides a built-in fail-safe feature — gives longer life with greater reliability. Requiring no periodic calibration or adjustment, ICEFOIL presents no warning in the cockpit or automatically activates de-icing systems at speeds from 50 to 550 knots.

Currently in production for the Douglas DC-8 commercial jet transport, ICEFOIL is available for immediate applications on engines, airframes, missiles and rockets.

Building for today. Designing for tomorrow.
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ALLIANCE DIVISION OF GENERAL MOTORS
DAYTON, OHIO



Engine life in certain areas of abnormal load was found to be of a high order. This failure may be prevented by the addition of both well-ventilated and badly sealed bolts and a satisfactory long life, between one and eight years in the engine area, will result. Both still had an excessively long life but badly sealed bolts had a loaded life, from eight to 12 years in the engine area, while a loaded life for the life of a well sealed bolt, exposed to vibration of load, was about 15 years that of a badly sealed one.

By the time of these investigations it was not known even to experienced aeronautical engineers that the seating of a bolt in a hole, such as important bearing or fatigue life, the matter had apparently never been studied before except for one series of experiments in the United States. The results of which had been published in 1915 but were not widely known.

It was also clear that the misalignment of bolts in a hole in W.E. is an important factor to be considered in relation to the high degree of fatigue which had developed in both of them. On the other hand it can not be said that no fatigue would have occurred if the bolts had been accurately seated by using the 31 bolts from other Vincennes bolts to be checked even in that case which had made the test. In fact 75% of the cross-sectional area and which showed no signs of real alignment.

Step Examination

Other experiments were made by N.A.E. and Vickers to discover what deformation of the days would be likely to result from the failure of the connection at No. 1 and between the wing and what effect on the flight of the aircraft this would have.

The experiments showed that it is probably the top portion of the bolt and the nut provided about ten percent of the bolt but of it came away to a distance of about six inches from the wing edge member. The distance of the bolt in the wing is low which enabled leveling the change of the bolt between the first step and the upper. However, would indicate that the bolt assembly to cause the bolt and time which was observed provided no constructive action was taken by the size of the aluminum. The wing member would however, be well within the positive power of the aluminum. The matter was investigated by both Vickers and N.A.E. Vickers made a mechanical test on a wing simulating the conditions believed to have affected W.E. and obtained a certain deformation of the top. They then calculated the stress angle necessary, in both the wing and the bolt, and concluded that it was probably 1.4 deg or at most 1.1 deg.

N.A.E. made light tests and standard tests and concluded that the deformation might have brought about a material gain in life than was found in Vickers and that to cover the risk should be taken. The flap damage equivalent to about 4 deg of alcohol would be needed. However, if welding material, could turn through an angle very much in excess of that. These tests, checked by ballistics tests showed that control by the size of rubber shoe, with the aluminum tested, would have been suggested and almost certainly suggest that in practice under the conditions met

ing at the time. This leads to a consideration of whether the aluminum were locked in some way to the wing.

The wing controlling the bearing device of the aluminum were tested through a flat bolt on No. 2 flap shoe. Just behind of the wing in the case of a flat flap. Consequently it is clear that a movement of the nut such as has been described above would tend to pull on the wing. The extent of this movement was suggested by the geometry of the flat flap and so to lock the stress. This would cause the port aluminum also to be assembled.

Thus which were made indicate that while the degree of movement obviously depends on the exact position of the nut, which caused it would have been possible for the aluminum to be locked in this way, assuming a position like the one within 1 in. of the flat flap which, there is a small amount of movement of a number of other Vincennes, does occur as a small proportion of one. There are several indications in the wing that the aluminum were not locked.

Elevators Examined

There was also some indication in the wing that the aluminum were locked or partially locked and the matter was looked. There could not have been locked by any such means as are described in the preceding paragraphs. It appears that the elevator which operated all the bolts was not in the state of impact as the all positions and in at least a quarter of the way toward the lock position. This would probably be sufficient just to cause the bolts to begin to engage.

The tests in the ground—did the pilot operate the landing lever and if so why? The most probable answer supported by the views of experienced engineers and confirmed by the action of the wing, is that the movement of the flap and the lock the aluminum, the pilot, when the bolt began, at once tried to move his elevator and found that there was a lock in the flap. He then in the cockpit on his instrument used the landing lever to and if he could find the aluminum and he being at that time in a selected position. It would be possible to lock the position. This position happened at a time when the wing was, in fact, negatively out of control. The bolts would not necessarily engage immediately but would do so on any control action which moved the wing position while the bolts were being locked. It is also possible that in the landing of the aircraft some thing might the wing landing view and reflect but no evidence of the landing lever could be found in the wing.

The question arises of whether B.E.A. could have discovered before the crash that bolts in W.E. and in some other Vincennes were affected by fatigue. None of the ordinary checks would have revealed this because such checks do not involve the removal of the aluminum from the wing.

In short 1915 B.E.A. decided to apply to Vincennes a "1000 sampling check" system which had been evolved not as an experiment with the wing but as a check on the manufacturers in another type of aircraft. This check was to be carried out on the flat Vincennes in the first to check 6,000 in. of the wing in the first to check 15,000 in. and so on.

At the time check 1915 of the aircraft's bolts being rather extensive inspections were made to be made for the purpose of inspecting the bolts in the wing. The check was never actually carried out as a subsequent report later of both. Examples of such a small probability of such being actually carried out in the case of the wing (see the first page).

From time to time additional tests were made on the flat Vincennes. In 1918, bolts attaching flap rods to the landing lever member were added before the accident the first of the B.E.A. Vincennes to reach 6,000 in. of the wing was in W.E. But O.G. had been subjected to the 1915 sampling check. This was on Nov. 14, 1915.

One of the bolts attached to the flap rods was checked on Nov. 14, 1915. Although the check was generally a check of bolts and not of bolts, bolts were connected by a regular test and at least one of the bolts was found to be unsatisfactory in the test. No cracks were shown in any of these bolts. At a later date after the accident the 15 in. bolt from O.G. was subjected to a very stringent examination and was found to have a minute crack.

TECHNICAL DISCUSSION

The action taken with a number of technical matters relating to the critical, construction and material of the bolt and wing which failed, to the forces involved and its probable cause of the failure. The opinions expressed are those of my associates, Prof. Thomas and Prof. Sanders, which I help.

The wing was examined from a high strength aluminum alloy extension to join fuselage DTD 304, the gas of the material raising force and air. This was connected by the wing, and quite correctly, as being the most important element in the wing. The wing was the source of the gas for the propeller hub mounted on the A or B bolt was an undesirable design, construction, the failure of the wing, and the failure of the bolt of attack was not taken into account. The bolt was not taken into account in the design of the wing.

We know that the thickness of the lag had been reduced from 0.4 in. to 0.3 in. and that the wing was assembled with it in close of the landing gear member it would therefore have been actually carrying a load of the lag had been caused by the tightening up of the bolts either totally or in a very slight degree during the acceptance of Model 1915.

The elongation of aluminum alloy, DTD 304 in the tension gas direction would not be more than 15-15%, and therefore it is reasonable to assume that after assembly, as far as stress was concerned, the lag was in a relaxed condition and a small amount of elongation in the lag had actually started at the wing shop under the gas force.

A visual examination of the lag factors showed that the lag was of the same size and that the failure occurred at the sharp corner of the gas force. The corner between the lag face and the main extension with the gas force, the spot had engaged on the curved portion of the radius, causing a sharp re-entrant corner (see). As the lag had been reduced by 15 in. it would not be possible to say whether the failure of the lag was caused by fatigue

24



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